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DECISION MAKING

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DECISION MAKING

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To my sons

GERRY, JOHNNY, STEPHEN and MARK

who live in a

world of increasing complexity.

PREFACE

Most people have had occasion to look back on various decisions affecting their business and personal lives with a mixture of both pleasure and regret. In both situations it is usually difficult to determine the real factors which influenced the decisions. While time tends to blur our recollections of details and we may offer what appear to be creditable reasons for our behavior, a searching review often reveals that a decision was not as well considered as it might have been. Frequently our good and bad choices resulted from a combination of random knowledge and a limited understanding of consequences.

Observation of many decisions in both business and government has led to the belief that most decision making can be improved. While this is not meant to imply that either government or industry has made a high percentage of poor choices, it has been interesting to observe in retrospect that some decisions which provided satisfactory results were primarily the result of chance. Similarly it has been obvious that better choices would have produced better results.

If the assumption that decision making can be improved is accepted, the obvious question is how? It is the purpose of this paper to provide an answer to the question by reviewing some of the past and present contributions to the process of decision making. In so doing, the process will be discussed with emphasis on making a decision and only brief reference to the execution of a decision. Chapter II reviews some of the contributions of philosophy,

psychology, economics and statistics. This is followed in Chapter III by some representative decision theories and hypotheses. Decision making methods are discussed in Chapter IV and group decision making in Chapter V. The new analytical techniques and theoretical approaches to decision making are explored in Chapter VI.

The making of better decisions is vital to the efficient allocation of resources and our survival in today's complex world. Further, making better decisions as well as more "good" decisions is of universal concern to every level of management in industry and government.

The preparation of this paper has been a challenging and satisfying experience. I am deeply indebted to Dr. A. Rex Johnson, not only for helpful assistance with this paper, but, also, for his able direction of the Navy Graduate Financial Management which has clarified for me the meaning of the word "education."

I must also acknowledge my appreciation and thanks to Dr. Richard Ericson who introduced me to contemporary theories of administration, organization and management; to Miss Helen McNulta who offered many helpful suggestions; to Mrs. W. H. Moore for her typing and editing assistance; and to my wife, Elaine, who took over the family in true Navy tradition during my "absence" while working on this paper.

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Lieutenant Commander
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CHAPTER I

INTRODUCTION

A man has to ignore much to get on with something.
--A. N. Whitehead

Decision making has been recognized as one of the most critical functions of business executives, military officers and politicians. One author, in discussing the part which decision making plays in management, treats "decision making" as though it were synonymous with "managing."[1] Also many management texts contain references to decision making which state that it is the heart of managerial activity. The process of decision making is, however, subject to considerable speculation. Many businessmen frankly admit that they don't know how they make decisions. Few if any of them consciously apply rational methodology. Instead they look to knowledge, previous experience and the exercise of good judgment. At times such judgment is not far removed from hunches, educated guesses or intuition. At the other extreme of the decision-making spectrum are the new analytical techniques and theoretical approaches. The giant among these is the computer and the claims for it which include great capabilities for policy decision making.[2]

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[1]Herbert A. Simon, The New Science of Management Decision (New York: Harper and Brothers, Publishers, 1960), p. 1.

[2]Herbert A. Simon and Allen Newell, "Heuristic Problem Solving: The Next Advance in Operations Research," Operations Research, January-February, 1958, p. 9.

Neither of these extremes, which may be characterized as judgmental and analytical, constitute the whole of the decision-making process. Rather, there is a large middleground of conventional theories, concepts and methods which attempt to make decisions by the methods of science. In varying degrees they employ logical analysis and careful empirical observation. As might be expected, the theories and concepts have originated in diverse fields, each of which has contributed a special point of view.

To set the stage for decision making a definition of the word "decision" is needed. Most dictionary definitions are only partially satisfactory in suggesting that "decision" is a settling or terminating or a conclusion arrived at after consideration. A definition which better describes the process to be discussed in this paper is:

> We shall think of a decision as a course of action chosen by the decider as the most effective means at his disposal for achieving the goals or goal he is currently emphasizing - for solving the problem that is bothering him. Note that a decision is something quite apart from the actual performance of the act that has been decided upon; it is a conclusion that a man has reached as to what he (or others) should do later - sometimes only a moment later. It is a solution selected after examining several alternatives - chosen because the decider foresees that the course of action he elects will do more than the others to further his goals and will be accompanied by the fewest possible objectionable consequences.[3]

Most of the literature does not differentiate decision making from problem solving. Numerous authors use both terms in the same context. A similar finding recognized this practice and also chose to use the words somewhat interchangeably.[4] A distinction between decision making and problem

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[3]Manley Jones, Executive Decision Making (Homewood, Illinois: Richard D. Irwin, Inc., 1957), p. 5.

[4]Niilo Nieminen, "A Survey of Problem Solving Methods," (unpublished Master's thesis, School of Government, The George Washington University, 1959), p. 2.

solving has been provided:

> The only kind of decision that really centers in problem-solving is the unimportant, the routine, the tactical decision. If both the conditions of the situation and the requirements that the answer has to satisfy are known and simple, problem solving is indeed the only thing necessary.[5]

This is only one view and it has not been recognized and accepted by all of the contemporary theorists. However, since most decisions must be made under varying conditions of uncertainty which do not permit an exact solution, the term "decision making" will be used in this paper. It should be observed that many of the references cited do not always do so.

The acceptance of the term decision making seems reasonable when the basic types of decisions are considered. These are: decisions under certainty, decisions under risk, and decisions under uncertainty. In decisions under certainty the outcome is 99-44/100 per cent assured. Decisions under risk permit consideration of various possible futures whose probabilities can be estimated. Less information is available than in decisions under certainty. Where the decision maker considers various alternatives whose probabilities cannot be estimated because of even less information than in decision under risk, the decisions are under uncertainty.

Decisions may also be classified in regard to the bases used by decision makers. Such a classification includes those who make decisions by: (1) intuition and hunches; (2) impetuously jumping to a conclusion; (3) brooding and hesitating; (4) being content to identify two or three alternatives; (5) being dissatisfied until every conceivable possibility has

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[5]Peter F. Drucker, The Practice of Management (New York: Harper and Brothers, Publishers, 1954), pp. 351-352.

been explored; (6) being insensitive to change and always using what has worked before; (7) being so sensitive to every possibility that each situation is treated as an entirely new and unknown thing.[6]

The foregoing list suggests that decision makers possess differing qualities, but does not indicate the qualities or skills usually needed to make sound decisions. Three of the skills on which effective administration has been said to depend are technical, human and conceptual. The conceptual skill, which requires an understanding of the totality of an organization and the interrelationships of its components for specific functions, becomes increasingly more important with the need for policy decisions and broad-scale action.[7] A more comprehensive analysis sets forth the intellectual qualities of a manager. These have been summarized under the general headings of factual attitude, quantitative attitude, logical qualities and qualities of action.

Factual Attitude. Have patience and desire to get the facts, be reluctant to jump to conclusions, but do not hesitate to use such reasoning and judgment as you must if lack of facts or lack of time prevents thorough research of a problem.

Quantitative Attitude. Strive patiently and creatively to prove the results of your decision by searching for variables that can be measured, but do not let yourself be enchanted by mathematical systems to the point where you postpone or shun judgment when action is necessary.

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[6]William A. Reitzel, Background to Decision Making (Newport, R. I.: U. S. Naval War College, 1958), pp. 24-25.

[7]Robert L. Katz, "Skills of an Effective Administrator," Harvard Business Review XXXIII, 1 (1955), p. 34 and p. 39.

Logical Qualities

(1) Modified Theoretical Attitude. Reasoning and quiet thought and the use of theory from others can be valuable in professional practice, provided I maintain a healthy distrust and willingness to abandon theoretical concepts if they do not fit my specific problem.

(2) Modified Attitude toward Truth. Do the best you can in the time available and use the terms that have proved to be most useful in your thinking.

(3) Modified Attitude toward Consistency. It will sometimes be necessary to substitute "reasonableness" in a broad sense for syllogistic precision in thinking.

Qualities of Action

Attitudes that Influence the Action-centered Mind

(1) A desire to change things to obtain results.

(2) A predisposition for timely action instead of waiting for a deluge of facts.

(3) Judgmental qualities which are broken down as conceptual judgment, quantity judgment and whole problem judgment. Conceptual judgments involve areas where ideas cannot be reduced to fundamental concepts. Quantity judgments are those in which the effects of taking certain known numerical actions cannot be used to predict quantitative results for specific factors. Whole problem judgments involve thousands of chain effects and must be decided on the basis of incomplete knowledge of all of the relationships.[8]

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[8]Charles E. Sumner, Jr., "The Managerial Mind," Harvard Business Review (January/February 1959), pp. 69-78.

These intellectual qualities, particularly the quantitative attitude, bring to mind an ability which is mentioned more and more in decision making: creativity. It has been said that:

> People who are creatively alert are much more interesting than those who are not. They seem to belong to a different species, or perhaps to a higher level of evolution. They see not only what is but what might be; and the power to see what might be is one of the chief traits that distinguish human beings from one another.[9]

A recognition that particular qualities and skills are required for decision making leads indirectly to the importance of decision making. Economics teaches that resources are limited and must be efficiently allocated if we are to achieve our goals. This requires that sound decisions be made in a timely manner if we are to preserve our way of life, particularly in the event of a major armed struggle. In business and industry there has been an increasing need for better decisions as the "profit squeeze" and inflation have exerted their pressures. Firms which could show profits in sellers' markets have realized that their future depended on improved decision making in buyers' markets. In the federal government the complexities of this age require that decisions be more carefully considered yet produced in record time. In this regard, the committee system of decision making has been attacked from many quarters because it places a premium on the cultivation of a nice mixture of noncontroversialness and colorless semicompetence while denying the men with the final responsibility the clear, sharp choices which they need to make.[10] The trends indicate that future

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[9]Harry A. Overstreet, The Mature Mind (New York: W. W. Norton and Co., Inc., 1949), p. 104.

[10]Stewart Alsop, "The Trouble with the State Department," The Saturday Evening Post (March 3, 1962), p. 14.

management will become analytical and scientific, administration per se will attain professional status, and business decisions will be set in a framework of political and social mores as well as the market place. In such an environment independent problem-solving ability is the critical element in the skills of a professional man.[11]

None of the foregoing has stated how to improve decision making. Rather it has followed the theme of most popular literature which provides perspective to the decision-making process by discussing some types of decisions, qualities and skills of decision makers, and the importance of decision making.

It is a basic premise of this paper that decision making can be improved. Such improvement requires: (1) an understanding of the contributions of various disciplines, theories, methods and techniques; (2) an appreciation of the applicability of these contributions, particularly the gaps in knowledge and limitations of methods and techniques. The significant contributions of philosophy, psychology, economics, and statistics will be reviewed in Chapter II.

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[11]G. Leland Bach, "Accounting Education for the 1980's," The Journal of Accountancy (September, 1961), pp. 50-51.

CHAPTER II

CONTRIBUTIONS OF SELECTED DISCIPLINES

An amazing amount of progress toward understanding the decision-making process in the technical sciences, statistics, mathematics and electronics, has been made in the past 15 years. In psychology and sociology, work has been done on perception, memory, attitudes, learning, personality, motivation, communication flow, opinion leadership, and social strata and mobility.[1] The field of statistics, which previously contributed probability sampling, has in more recent years perfected a new development called statistical decision theory. This approach combines both judgment and statistical evidence in making decisions.

Usually each discipline adopts a different point of view. The economist is concerned with economic choice and maximization through choosing the best available alternatives. Some psychologists have been concerned with considerations of the threshold levels that limit the sensitivity of response to various stimuli. Other psychologists have instigated decisions to select alternatives from a set of choices by subjects faced with varying forms of uncertainty. In the studies of small-group behavior there has been

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[1]Joseph W. Newman, "Put Research into Marketing Decisions," Harvard Business Review (March-April, 1962), p. 105.

some overlapping by the psychologist and the sociologist. Statisticians have come closer to the behaviorial sciences in their more recent decision-making theories. More and more it has become apparent that decision making includes many diverse fields and that an interdisciplinary approach has resulted in much of the progress.[2]

It is not possible to review in detail all of the contributions to decision making by every known discipline. A review of some of the major contributions of philosophy, psychology, economics and statistics will provide a frame of reference for the decision-making process.

Philosophy

Philosophy has provided some of the primary insights to problem solving. Essentially these are in the areas of logic and scientific method. John Dewey is referenced in much of the literature for the stages in problem solving which he first described:

What is the problem?

What are the alternatives?

Which alternative is best?[3]

In a later work, Dewey discussed the pattern of inquiry in such manner as to aid problem formulation and identification.[4] Inquiry is defined as the controlled or directed transformation of an indeterminate situation

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[2]Martin Shubik, "Studies and Theories in Decision Making," Administrative Science Quarterly (December, 1958), p. 289.

[3]John Dewey, How We Think (New York: D. C. Heath and Company, 1910), chap. 8.

[4]John Dewey, Logic - The Theory of Inquiry (New York: Henry Holt and Company, Inc., 1938), chap. 6.

into one in which the elements of the original situation are converted into a unified whole. Five steps are then listed through which an original situation, where the constituent parts lack unity, may be converted:

1. The antecedent conditions of inquiry: the indeterminate situation.
2. Institution of a problem.
3. The determination of a problem-solution.
4. Reasoning.
5. The operational character of facts-meanings.

The process begins with the unique indeterminate situation which is differentiated from other indeterminate situations not only by uncertainty at large but the peculiar quality of the given materials. While the indeterminate situation comes into existence through existential causes, the peculiar quality of the indeterminate situation exercises control over the special procedures employed in the inquiry. Problem institution stems from subjecting the indeterminate situation to inquiry. In the process, a partial transformation is effected. Discovering the problems which such a problematic situation presents for inquiry is to be well along into inquiry. At this point it is important to note that:

> The way in which the problem is conceived decides what specific suggestions are entertained and which are dismissed; what data are selected and which rejected; it is the criterion for relevancy and irrelevancy of hypotheses and conceptual structures.[5]

In the third step, determination of a problem solution, it is necessary to seek out facts of the problem and ideas of possible relevant solutions. This

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[5] Ibid., p. 108.

effort is toward formulation of the problem in such terms that inquiries will move toward the solution. In so doing it must be recognized that no completely indeterminate situation can be transformed into a problem possessing definite constituents. The fourth step of reasoning requires that the meaning of ideas be developed in their relation to one another. Exact thinking in the sense of ratiocination is required. A meaning more clearly relevant to the problem in hand than the original suggested idea should finally be reached. The remaining step of the operational character of facts-meanings necessitates that the existential facts pertinent to locating and describing the problem be compared with the meanings of the non-existential ideas. To the extent that there is agreement, the interaction of facts and ideas should furnish a sequence of suggestions and point to a possible solution.

Logic, as might be expected, offers a sound basis for the objective rationality which is sought in decision making. Traditionally it has been concerned with the study of what constitutes proof or conclusive evidence. In cases where the conclusion is implied by certain premises, the reasoning from the latter to the form is called deductive. A movement from the given partial and possibly confused data to a suggested comprehensive entire situation is inductive. Generally, the inductive movement is toward the discovery of a binding principle; the deductive toward its testing. This double movement is characteristic of reflection where the problem fixes the end of thought and the end controls the process of thinking. In this same vein John Dewey has written that:

> Active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends, constitute reflective thought.[6]

It should be further noted that facts cannot be discovered without reflection, and the facts for which every inquiry searches are propositions for whose truth there is considerable evidence.

Another concept of value to decision making is systematic inference. It may be defined as the recognition of definite relations of interdependence between previously unorganized and disconnected considerations. We infer one proposition from another validly only if there is an objective relation of implication between the first proposition and the second. It is essential to distinguish inference, which is a temporal process, from implication, which is an objective relation between propositions.[7]

Good judgment is necessary to distinguish between observations and inferences. Observations result from utilization of the senses to see, hear, feel, smell or taste. Inferences, on the other hand, are decisions which are correctly or incorrectly drawn from our observations. Most inferences require further testing to insure that erroneous conclusions are not formed. The "Uncritical Inference Test' has been designed by Dr. Wm. V. Haney of Northwestern University to train executives and military men to distinguish between observations and inferences.[8] A sample test is reproduced in

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[6]Dewey, How We Think, p. 6.

[7]Premises and conclusions are propositions. For purposes of logic a proposition may be defined as anything which can be said to be true or false.

[8]"Test Your Judgment," Nation's Business, January, 1962, pp. 66-69.

Appendix A.

In relation to scientific method, scientific thinking analyzes the present case, varies conditions one by one and notes what happens when a given condition is eliminated. It relies on observed differences and varying conditions to create differences. Scientific reasoning is a combined process of analysis and synthesis. Through analysis one fact may be found to be the key to a phenomenon. In synthesis, the opposite of analysis, separate elements of thought are combined with a group from which they were previously isolated to form a whole.

Some of the pitfalls which logic and scientific method warn against are in the nature of stable beliefs. Habit or inertia makes it easier for us to continue to believe a proposition simply because we have always believed it. A method other than tenacity is required for achieving stable views. Appeal is also made to authority for substantiation of views. This is usually done by having a question resolved by experts whose authority is acknowledged. It obviously fails where the experts don't agree. An even weaker appeal to authority results from investing some source with finality and using external force to sanction such decisions. Methods of intuition which appeal to "self-evident" propositions are often found to be capricious and willful. The belief that the "earth is flat" was founded on such an indubitable conviction of truth. Tradition, instruction and imitation represent thoughts that grow up unconsciously and without reference to the attainment of correct belief. Empirical thinking in the sense of learning from repeated observations that certain things always happen in a particular fashion or pattern is also to be guarded against. It can lead to false

beliefs, inability to cope with the ill-structured novel, dogmatism, unjustifiable conservatism and laziness.

A methodology for decision making which is slightly expanded from the one originally provided by John Dewey consists of:

1. Problem.

2. Formulation of a relevant hypothesis (suggested explanation or solution).

3. Possible alternative hypotheses (logic aids in formulating propositions explicitly and accurately, so that possible alternatives become clear).

4. Consequences (compare with observable phenomenon and test which hypothesis is to be eliminated).[9]

The steps in this methodology are self-explanatory with the exception of the problem stage. It is significant to note in this respect that philosophers have emphasized that no inquiry can get under way until and unless some difficulty is felt in a practical or theoretical situation. It is the problem or difficulty which guides the search for order among the facts, in terms of which the difficulty is removed. The ability to perceive a problem, particularly a problem whose solution will facilitate the solution of other problems, is not a common talent. Few rules can be given which enable men to investigate and ask questions about situations. Sensitivity to difficulties may be the trait which distinguishes scientific genius.

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[9]Morris R. Cohen and Earnest Nagel, An Introduction to Logic and Scientific Method (New York: Harcourt, Brace and Co., 1934), p. 195.

Finally, to those who feel that common sense is adequate for decision making, the following is appropriate:

> Common sense is content with a miscellaneous collection of information. As a consequence, the propositions it asserts are frequently vague, the range of their application is unknown, and their mutual compatibility is generally very questionable.[10]

Psychology

Psychologists have been concerned with how best to encourage and improve problem-solving abilities. Generally the field is in an unsatisfactory state as psychologists have raised more questions than they have answered. Certain contributions, however tentative, have been made in problem identification, terminology, approaches to problem solving, and in factor analysis.

The problem situation is said to exist when there is a perplexity about how to overcome a difficulty. It involves a breakdown in the previous pattern of relationship between an organism and the environment in which it operates. It is only when a novel situation arises, one for which there is no effective adjustment response available, that you can significantly talk about a problem situation. The situation itself does not make adjustment difficult, however, unless there is a strong and compelling compulsion on the individual to find a satisfactory solution. A related element is that uncertainty is involved and closely related to uncertainty is the matter of expectation. Some writers speak of uncertainty situations rather than problem situations. An uncertainty situation can only be resolved at some future point

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[10] Ibid., p. 392.

in time as a consequence of action taken in the present. To decide, plan and execute action in a rational manner, the desired future situation must have first been established as a goal, objective or purpose.

Problem situations exist in a spectrum that runs from the individual confronted by uncertainty, through any organized group of human beings confronted by obstacles to the achievement of their purposes. The ways in which the elements of novelty, uncertainty and compulsion are related and affect the decision-making response differ for any given part of the spectrum. Regardless of where on the spectrum a problem situation is located, it is dealt with either by individuals in isolation or by individuals associated in organized groups. The individual human response to a problem situation is, therefore, the foundation of the decision-making process.

In reacting to a situation it must be realized that man possesses a very limited span of attention and a severely restricted memory. The problem is to narrow the range of observations to those essential for acting in the immediate situation. The basic technique is to reduce diversity to simple formulas by being selective. It is called perception and in this view is "a decision process played on a probability basis--a gambling in selectivity."[11] The gamble is guided by two simultaneous motivations with respect to outcome: (1) to maximize gratification and be in a position to achieve an expectation; (2) to minimize surprise and be in a position to cope with contingencies.

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[11]Reitzel, op. cit., p. 6.

Modification of the selectivity pattern may be achieved through learning. Training emphasizes repetition and the build-up of habitual reflex responses. As such it introduces additional risks of inadequate responses in uncertainty situations. Indoctrination has understanding as its basis and the utilization of conscious flexible response. Both training and indoctrination operate at varying degrees in human learning but produce different results in the way that meanings or knowledge is subsequently used.

In the section on philosophy, brief mention was made of problem sensitivity. Psychologists have found that this trait varies widely from person to person.[12] It appears to be related to the extent to which an individual shows "openness to experience" or is "conscious of his surroundings." The capacity to define a problem accurately in relation to objectives has been termed "goal-oriented problem solving." The opposite is the "technique-oriented problem solver" who finds it difficult to define a problem realistically but easy to make a problem fit a prescribed formula. Such persons are usually quick to offer a standard, tried and true solution but very slow to test this solution for actual relevance.

Two approaches employed by psychologists are what may be termed psychology of learning and personality and social psychology. The first relates problem solving to learning and thinking, a cognitive process, in which a high-order but not necessarily original product emerges. The second is concerned with personality manifestations and looks for social and motivational determinants in addition to the purely cognitive ones.

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[12]A trait is any distinguishable, relatively endurable way in which one individual differs from another.

The psychology of learning approach applies to problems which involve a correct answer or solution. To accomplish this the problem must be sensible and have meaning for the learner. In 1953 and 1954, Hilgard found that results achieved by understanding are retained longer than those learned by rote.[13] The lesson to be learned from these studies is that the extra time and effort needed to learn by understanding is well spent when it comes to dealing with new problems similar to but at the same time different from the ones used in training. There is also a belief that miscellaneous uncoded facts, stored in memory as isolated fragments, may overtax our systems and certainly not be fully useful in solving problems.[14]

One of the unfavorable circumstances of the psychology of learning approach is that there is often too much persistence in following a single direction that is no longer appropriate for the solution of a problem. When we get "set" in one way of regarding things, we often fail to consider other possibilities. In some cases we lose flexibility because we are satisfied with a particular course of action and do not seek additional alternatives. The concept of "functional fixation" has been invented to explain why we employ certain tools only in established and traditional ways. In certain experiments it was found that the more time elapsed between normal and novel use of an object the less the functional fixedness. This may partially explain why a baffling problem is sometimes solved upon our return to it after a period of absence.

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[13]Ernest R. Hilgard, "Creativity and Problem Solving" in Creativity and its Cultivation, Edited by Harold H. Anderson (New York: Harper and Brothers Publishers, 1959), p. 167.

[14]G. A. Miller, "The Magic Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information," Psychological Review (Vol. 63, 1956), pp. 81-97.

The personality and social psychology approach views the problem solver as one and indivisible. He does many things at the same time. In various situations and time frames the problem solver demonstrates trial and error, insight, the influence of social conformity, and even traits such as masculinity. In this regard there appears to be a sex difference favoring men where the problems to be solved are of the kind requiring some restructuring of the problem before it can be solved. Another experiment found that under conditions where a subject has to assert his convictions when he is a minority of one against a majority of four, the nonconformist in this situation is a better problem solver.[15]

Factor analysis has been used to discover primary traits related to creativity and problem solving. Guilford has found these traits to be:

1. Ability to see problems or a generalized sensitivity to problems. (Without this step productive thinking would not be initiated.)

2. Fluency of thinking--relates to the quantitative aspect of producing ideas.

3. Flexibility of thinking--not persisting in wrong but inviting directions.

4. Originality--tested by unusualness of responses.

5. Redefinition--giving up old interpretations of familiar objects to use them or their parts in some new way. Has also been called "functional fixation."

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[15]Hilgard, op. cit., p. 171.

6. Elaboration--quantitative addition of detail.[16]

Factor analysis has not detected a unitary ability to solve problems. A number of unitary abilities are involved, but their combination and respective weights depend upon the kind of problem. Fluency, flexibility and originality fall in the general category of divergent thinking. This is characterized by searching activities with freedom to go in different directions. Redefinition is considered in the category of convergent thinking. This involves proceeding toward one right answer that is more or less clearly demanded by the given information. Sensitivity to problems is placed in the category of evaluation. This as the name implies relates to the evaluation of information, of responses derived from the information, and of conclusions. In so doing, decisions as to whether problem solutions are correct, adequate, suitable, etc., are made.

The question of whether a group or an individual does better thinking in problem solving has not been answered. To date the results are about a draw, so far as laboratory problems are concerned. Most group results do not indicate any efficiency over a number of individuals working separately and pooling their findings.

Economics

Economics has often been assailed as too theoretical and too indefinite by those who seek exact and precise answers. Much of this feeling results from the fact that the economist never developed rules useful to the

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[16]J. P. Guilford, "Traits of Creativity" in Creativity and its Cultivation, Edited by Harold H. Anderson (New York: Harper and Brothers Publishers, 1959), p. 145.

businessman. In many instances economists have developed U-shaped cost curves and postulates to show the point at which marginal costs equal marginal revenue. Such advice has not been useful because of the difficulty of determining marginal costs.

Today the Department of Defense and the federal government are more concerned about economics than ever before. The limitations on human, natural, capital and institutional resources present some hard choices, not only between individual and collective wants, but more particularly in deciding how much of our resources shall be devoted to various ends such as defense, agriculture, education, welfare, etc. Such decisions necessitate the establishment of goals and a knowledge of the means to be used to achieve these goals. Economists cannot provide good answers until they know what is wanted, the goals to be sought and their order of preference.[17]

Decision-making models of economic man, particularly as he is described in the theory of consumer choice, present him as a rational, all-knowing person who chooses among well defined alternatives in such manner as to maximize his utility if he is a consumer, or his profit if he is a businessman.[18] Unfortunately this model is not realistic, as evidenced by the number of business failures every year due to the ignorance of costs or methods of business.

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[17]Dr. J. W. Skinner, Lecture, Navy Graduate Financial Management Program, The George Washington University, February 27, 1962.

[18]Shubik, pp. 473-93.

Economics does, however, offer a way of deciding the relative merits of various courses of action. It insists that we define problems in terms of facts and identify our objectives in some order of priority. It tells us to examine alternative ways to achieve objectives, and it gives us tools to measure the likely consequences of various possible actions. One of the best known tools in decision making is the indifference curve for expressing the relationship between goals or objectives. Over-all, economics provides a method for orderly thinking about our resources.[19]

Statistics

Statistics, as a body of knowledge, has contributed to decision making by facilitating the preparation of predictions and estimates in many situations. "The field of statistics involves methods and theory as they are applied to numerical data with the objective of making rational decisions in the face of uncertainty."[20] This definition is appropriate not only as it relates to decision making but to indicate that it is the subject of statistics rather than numerical data which will be discussed. Statistics relies on mathematics, the queen of the sciences, to state concepts, ideas and relationships. It is not surprising, therefore, to find that the subject of statistical decision making is discussed in the literature by many engineers, particularly industrial and management engineers.

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[19]Luther H. Hodges, "We're Flunking our Economic ABC's," The Saturday Evening Post (March 10, 1962), p. 10.

[20]Ernest Kurnow, Gerald J. Glasser, and Frederick R. Ottman, Statistics for Business Decisions (Homewood, Illinois: Richard D. Irwin, Inc., 1959), p. 17.

The role of statistics in the decision-making process is best examined by setting forth the basic characteristics of the decision-making process, as seen by the statisticians.[21] These may be summarized as follows:

1. A decision problem is a problem in deciding on a course of action. Unless action can be taken, a problem situation does not call for decision. This is the so-called "principle of action."

2. Alternative courses of action must be available.

3. Alternatives are classified as desirable or undesirable in terms of their consequences which depend upon certain conditions. To determine what these conditions are we must know the "true state of the world." In most problems there are many possible states of the world, and it is not always possible to determine exactly which is the true one.

4. Data for solution of a problem are gathered after a statistical decision rule has been formulated. In effect, the data are gathered for a purpose since a course of action which will be taken has been determined prior to the collection of data. This is known as the "principle of planning."

In a problem where statistics can be employed to reduce uncertainty, the problem must be translated into statistical terms. This involves defining the statistical population and specifying the decision parameter. The statistical population is the total relevant observations that can be made in a problem. When only a part of a population is observed, that part is called a sample. The decision-parameter is a summary of the observed data in a convenient form. Older reference books refer to measures of central

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[21] Ibid., pp. 4-16.

tendency and measures of variability in lieu of decision-parameter. In either case, the terms refer to the proportion, aggregate, arithmetic mean, average deviation, standard deviation, etc., where they are used for decision making and the complete population is available and used.

Having stated the problem statistically and chosen a decision parameter, it is necessary to decide whether data should be collected. In some instances the costs of making observations will exceed the value to be derived from the observations. If data are to be collected, it usually is necessary to employ some type of sampling method. Since sampling introduces risks, it is necessary to utilize probability sampling,[22] in which the risks can be objectively evaluated. One of the applications of probability theory, developed by mathematicians, is statistics. It permits predictions of the variations which can be expected in a statistic which summarizes some information about a sample. Since probability should be expressed quantitatively, a numerical measure of probability is employed. Generally it is interpreted as the proportion of times an outcome would occur in an infinite series of repeated trials.[23] The most common example is that of flipping a coin where the probability of a head is 50% in the long run.

Estimation methods may be considered schemes for making statements about the future. The basis for estimating probabilities is past experience and the assumption that all outcomes are equiprobable. Prediction means that

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[22]Ibid., p. 119. Probability sampling is a selection procedure in which every elementary unit has an ascertainable chance of appearing in the sample.

[23]Ibid., p. 151.

some explicit method of collecting data on past events is employed, and inferences about the future are then made from the data. Judgment on the other hand is characterized by resorting to guesses, expert opinion, etc. A more sophisticated term that has recently appeared is "subjective probability." It has been defined as the decision maker's judgments, guesses, or feelings about the likelihood of a future event. "In most decisions a complex mixture of prediction and judgment is actually used."[24]

All problems of measurement, including the measurement of values, involve the construction and use of scales.[25] These fall into three basic types: ordinal, internal and ratio.

The ordinal scale is simply a ranking. Through the method of paired comparisons the task is made easier and a check on the internal consistency of value judgments is obtained. In it the decision maker considers outcomes two at a time and indicates the preferred outcome for each pair. This is carried on until all possible pairs of outcomes have been subjected to comparative value judgment. Where there are n outcomes, n(n-1)(1/2) pairs must be judged. For an ordinal scale to be constructed all value judgments must be changeable and temporary. Since ordinal scales are based on judgment, their validity is most questionable.

An internal scale has an arbitrary zero point and a constant unit of measurement. A ratio scale has an absolute zero point and a constant unit of measurement. When we evaluate an outcome in dollars of profit, we are using a ratio scale.

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[24]William T. Morris, Engineering Economy (Homewood, Illinois: Richard D. Irwin, Inc., 1960), p. 94.

[25]Ibid., p. 139.

A Joint Contribution

A general problem solving program has been developed by the Carnegie-RAND research group.[26] In the laboratory a problem, such as proving a theorem in Euclidian geometry, is given a subject and he is asked to think aloud while he solves it. The researchers realize that not all of the subject's thought processes will rise to the level of consciousness or be verbalized. They have tape recorded what was said, however, and later analyzed the recording. In so doing it was observed that the subject compared the theorem with a theorem he knew--that he looked for similarities and differences. These suggest subproblems whose solutions may contribute to the solution of the problem. In turn these generate subproblems until the subject comes to a problem he can solve directly. This results in a movement back up the scale of subproblems and the assembling of results which may aid in the solution of the whole problem. As the pieces fit together the problem solver persists in a particular direction. When they do not, the subject must explore other possibilities.

The general problem solver program was initially inferred from the studies of human thinking in the laboratory and subsequently coded for computer simulation. It is a program for reasoning in terms of ends and means, goals and subgoals, about problematic situations. It is believed to reproduce most of the thought processes of humans observed in the laboratory and to furnish some explanation for the organization of those processes. As reportedly conceived, the general problem solver will attack three types of goals:

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[26]Simon, The New Science of Management Decision, pp. 21-30. The research on complex information processes sponsored by the Graduate School of Industrial Administration at Carnegie Institute of Technology and the RAND Corporation, in which Herbert A. Simon and his colleagues--Allen Newell and J. C. Shaw--have been engaged, is described.

1. Transform goals: Change a into b.
2. Reduce difference goals: Eliminate or reduce the difference between a and b.
3. Apply operator goals: Apply the program (or operator or method) q to the situation a.[27]

Various methods of achieving these goals are associated with the three types. The method for changing a into b is to find a difference, d, between them and formulate the reduce difference goal f eliminating this difference. A method for reducing a difference between a and b is to find a relevant operator for removing the differences in question, and to apply that operator. A method for applying an operator is to compare the actual situation with a situation that would make it possible to apply the operator, and to formulate the goal of changing the actual situation into the required situation.

Summary

This brief review of some of the contributions of philosophy, psychology, economics and statistics provides a background for understanding the decision-making process. In philosophy the rational approach to decision making has been depicted in the objective processes employed in inquiry, the reasoning processes of reflective thinking and systematic inference, and scientific method. Two decision-making methodologies were described.

A different view of the problem situation was presented in the section on psychology. Attention was focused on individual human responses and some of the limitations of man. In learning it was shown that man is a better problem solver when he learns by understanding rather than by rote. Through

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[27] Ibid., p. 28.

factor analysis certain traits have been isolated which relate to problem solving and creativity. These are: (1) the ability to see problems or a generalized sensitivity; (2) fluency of thinking; (3) flexibility of thinking; (4) originality; (5) redefinition; and (6) elaboration.

Economics, while not offering simple rules for the businessman, does contribute to the difficult decision-making choices of allocating scarce resources. The decision-making approach of economics may be favorably compared with the methodology of philosophy. In economics a new factor of an order of priority for objectives was introduced.

Statistics facilitates the summarization of relevant data for the purpose of making predictions and estimates under conditions of uncertainty. More exact description is required in quantification which utilizes definiteness in procedures and thinking. Summarization of data aids in providing meaning and convenience in handling. Thus certain general conclusions may be drawn and predictions made. The basic characteristics of the decision-making process as seen by the statisticians are:

(a) The "principle of action." It must be possible to take action.

(b) Availability of alternative courses of action.

(c) Classification of alternatives under varying conditions described as "states of the world."

(d) The "principle of planning." Formulating an a priori decision rule before gathering data.

Three types of scales used in problems of measurement are ordinal, internal and ratio.

The joint contribution of the Carnegie-RAND research group is indicative of the efforts being made in heuristic problem solving. It may be possible from such work to discover how successful persons solve problems and to teach such procedures to others. While the procedures will vary with the situation, better decision making can result from the knowledge of how an individual should proceed. This entails the development of guides and patterns for making observations, seeking similarities and differences, transforming goals, and applying operator goals to situations.

CHAPTER III

SOME DECISION THEORIES AND HYPOTHESES

Decision theory is concerned with problems of choice. Older forms of the theory were primarily philosophical and concerned with how men and organizations should choose to achieve their objectives. These were the normative theories which offered recommendations and guides to decision making. Later forms of the theory were the descriptive theories which were concerned with how people or firms actually do make decisions, or with attempts to predict how a decision maker will actually choose. This later category of descriptive theories were psychological in nature. The contemporary form of theory attempts to combine both questions and tends to be concerned with both the should and the how. Combining the two questions alters the nature of the problem of choice and is concerned with the question of optimal choice.

> Practice has assumed that decision-making was something of an art; and as such rested upon the trained experience and judgment of individuals. Decision theory implies that there is a science of decision-making; that just as technological change rests upon a basis of mathematics and the physical sciences, so decision theory rests upon a basis of mathematics and the so-called "behavioral sciences".[1]

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[1]Reitzel, p. 80.

In terms of objective validated evidence, very little is known about how decisions are actually made, either by individuals or groups. The theories presented are, therefore, useful only to the extent that they provide insight and may furnish guideposts to our thinking.

Decision Theories

Probably the best known work representative of one of the older decision-making theories was written by Chester Barnard.[2] He states that:

> When decision is involved there are consciously present two terms--the end to be accomplished and the means to be used. The end itself may be the result of logical processes in which the end is in turn a means to some broader or remote end; or the immediate end, and generally the ultimate end, may not be a result of logical processes, but "given"--that is, unconsciously impressed--by conditions, including social conditions past or present, including orders or organizations. But whenever the end has been determined, by whatever process, the decision as to means is itself a logical process of discrimination, analysis, choice--however defective either the factual basis for choice or the reasoning related to these facts.

This statement emphasizes choice of means and logical process. Because of this it bridges the movement from normative to descriptive theory. While it can be argued that rationality should be sought, a principal difficulty in achieving rationality is the lack of complete information available to the decision maker.

The requirements of rationality have recently been set forth as explicitness of the decision process, logical consistency and logical truth.[3]

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[2]Chester Barnard, The Functions of the Executive (Cambridge, Mass.: Harvard University Press, 1951), pp. 185-205.

[3]Morris, pp. 4-5.

Explicitness refers to consciously carrying out the decision process in such a manner that all the elements and steps in the process can be listed and described. This includes stating the alternatives which were considered in a decision, how the consequences of choosing various alternatives were predicted, how these consequences were evaluated, what the decision was, and whether the decision was correct or in error. To the extent that this is achieved, decisions can be checked and reviewed by others, ways of improving bad decisions may be sought, and knowledge of decision making enlarged. Explicitness also makes it clear where in the decision process analysis was concluded and judgment begun.

Logical consistency refers to avoiding contradictions in the analysis of a decision. Where the goal is profit, decisions which will result in a loss are avoided. Alternatively, we try to avoid arithmetical mistakes and mistakes in mathematics generally. Consistency is not adequate alone, however, as it could lead to consistently wrong decisions.

Logical truth means that decisions must be in agreement with observations and inferences from these observations. It is another way of saying "get the facts." Because of the limitations of time, cost, analytical skills, and knowledge of decision making, nearly every significant decision involves a deficiency of certain information.

In his General Theory of Administration, Litchfield offers some minor propositions regarding how decisions are made.[4] They are:

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[4]Edward H. Litchfield, "Notes on a General Theory of Administration," Administrative Science Quarterly, I (1956), pp. 3-29.

Minor Proposition: Decision making may be rational, deliberative, discretionary, purposive, or it may be irrational, habitual, obligatory, random or any combination thereof. In its rational, deliberative, discretionary and purposive form, it is performed by means of the following sub-activities:

a. Definition of the issue.
b. Analysis of the existing situation.
c. Calculation and deliberation of alternatives.
d. Deliberation.
e. Choice.

In explaining the sequence of actions it is acknowledged that few decisions follow or fully utilize this pattern. The problem may not require definition; preconceived opinions and biases may cause only a superficial search for alternatives; and deliberation may be limited by the pressures of time, cost or availability of knowledge and skills. Further, the decision maker must allow, but probably doesn't, for his own irrationality as well as the irrationality of others.

Minor Proposition: Decisions become guides to action after they have been interpreted in the form of specific programs.

This involves program planning and its wide range of specific methods and techniques such as: organization charts, personnel levels, various budgets, and other means to translate the decision into the allocation of money, manpower, and material.

Minor Proposition: The effectiveness of a programmed decision will vary with the extent to which it is communicated to those of whom action is required.

This statement is self-explanatory; given that it is difficult to measure effectiveness in many instances, one of the problems in communicating a decision is to insure that there are adequate channels available of minimum practicable length to preclude distortion and misunderstanding.

Minor Proposition: Action required by a programmed and communicated decision is more nearly assured if standards of performance are established and enforced.

Varying techniques have been devised to assure performance which are characterized by the term "control." Usually control is accomplished through organization charts, function statements, budgets, and operating standards. A danger to guard against is that control does not become an end in itself.

Minor Proposition: Decisions are based on facts, assumptions, and values which are subject to change. To retain their validity, decisions must therefore be reviewed and revised as rapidly as change occurs.

An interesting parallel may be observed between this statement and the statisticians' concept of "states of the world." It will be recalled that the consequences of a decision must be appraised in light of existing circumstances and conditions, or predicted for the future. Litchfield in discussing this proposition offers the cybernetic thought that the decision itself may bring about sufficient change to warrant reconsideration. To intelligently review and revise decisions there is a critical dependency upon information generated by the original decision. This has been termed "feedback."[5] It should further be noted that many outmoded policies are based on conditions or facts which no longer obtain. A method of quantifying the costs of maintaining traditionally accepted policies has been advanced to demonstrate that many policies are inappropriate in the present socio-economic climate.[6]

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[5]Norbert Weiner, The Human Use of Human Beings: Cybernetics and Society (New York: Doubleday and Co., 1954), p. 20.

[6]Melvin Ashen, "Price Tags for Business Policies," Harvard Business Review, (January/February, 1960), pp. 71-78.

A third theory of decision making gives primary attention to the social context in which decisions are made.[7] The word "behavior" in each of the steps of the decision-making process indicates the psychological flavor of the process.

1. Awareness of behavior alternatives.
2. Definition of behavior alternatives.
3. Evaluation of behavior alternatives.[8]

These steps are somewhat similar to those previously noted in Chapter I, under Contributions of Selected Disciplines and also set forth under the first minor premise of Litchfield. Although a first step titled "problem" or "issue" is not supplied, Tannenbaum states in his discussion that the decision-making process is initiated by stimuli, internal or external to the individual which channel his attention in definite directions. Quite often these stimuli are accidental or arbitrary in nature and to this extent the individual's behavior is not rational. A further distinction is that there are definite limitations to rational behavior.

> These limits stem from the individual's lack of knowledge with respect to the existence of behavior alternatives and the consequences that will follow from them both from the subjective processes which are necessarily involved in defining alternatives when uncertainty is present, from time limitations, and from the psychological difficulties involved in holding alternatives and their consequences in focus preparatory to making a decision.[9]

The social context of decision-making behavior takes into account the influence of decisions on subordinates. Hierarchal decisions serve to improve the rationality of the behavior of subordinates for organizational purposes

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[7]Robert Tannenbaum, "Managerial Decision-Making," The Journal of Business, XXIII, 1 (1950), pp. 22-39.

[8]Ibid., pp. 24-25.

[9]Ibid., p. 24, underlining supplied.

in a number of ways.

1. Decisions which define enterprise purposes enable the members of a group to in turn make decisions with regard to the organization's goals rather than their own individual and personal ends. Training is used to teach organizational purposes; incentives are used to obtain acceptance of these purposes; supervision is used to insure that these purposes guide individual decisions.

2. Supervisors establish the criterion of rationality to guide subordinates in making choices. This criterion requires that optimal choices be made in order to maximize results at a given cost or to attain given results at the lowest cost.

3. Managers decide the types of specialization to be utilized in an organization and in so doing establish limits on the activity of the individuals filling particular positions.

4. The establishment of formal lines of authority permits the subordinate to know definitely from whom he receives decisions made to affect his behavior.

5. Superiors impose restraints on the general activity of subordinates which limit the number of available alternatives from which a subordinate must choose.

6. Superiors may be the primary source of information regarding alternatives and the consequences of specific behavior alternatives.

7. By setting deadlines superiors direct the attention of subordinates to particular problems and initiate the decision-making process.

8. Through formal and informal communications the superior may specify the behavior responses of subordinates on a designated subject. Here the subordinate need not make any decisions: just follow orders.

Since nearly every person has a boss, executives and top level managers are subject to many of the same types of behavior restrictions as they have placed on their subordinates. In addition, the boundaries of a manager's decision-making authority are set by the acceptance of such authority by those whose behavior is affected. While this concept may be difficult to accept at first glance, it receives more credence today than other theories of the sources of managerial authority.

Many individuals and groups, external to an organization, subject managers to their authority. The principal ones which impinge upon the manager's authority and consequently have an effect on his behavior are:

1. Government agencies: local, state, and federal.
2. Parties to contracts with management.
3. Monopolistic and monopsonistic economic groups.
4. Arbitrators.
5. Cartels, trade associations, and other business associations.
6. The general social order.[10]

It is not practicable to reproduce here all the concepts and explanations which the authors of the three previous decision theories have advanced. The central theme of each of these theories has, however, been extracted or quoted. While exact identification of these theories in terms of period is a difficult undertaking, it will be noted that the first theory contains elements of the older normative theories in its reference to logical

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[10] Ibid., p. 37.

process. The second theory may be more accurately labeled as a product of the field of administrative science. This field is characterized by: (1) its orientation toward sociology, social psychology and the social sciences "proper"; and (2) a concern for the broad application of theories and methods of the social sciences to the problems of organization. The third theory is more representative of the combination of both how men should and actually do choose. In it the criterion of rationality is directed toward optimal choice.

Hypotheses

Various disciplines and interdisciplinary efforts have offered numerous theories and hypotheses of decision-making. Having reviewed several theories of decision-making, it is appropriate at this juncture to look at some of the hypotheses which have been expressed about various phases of the problem-solving and decision-making processes. Although these hypotheses are more tentative in nature than the theories, they do stimulate additional thought and provide some basis for the prolific forms of decision-making methodology.

A central hypothesis of the theory of problem solving is that:

> In solving problems, human thinking is governed by programs that organize myriads of simple information processes--or symbol manipulating responses if you like--into orderly, complex sequences that are responsive to and adaptive to the task environment and the clues that are extracted from that environment as the sequences unfold.[11]

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[11]Simon, The New Science of Management Decision, p. 25.

While this statement is not intended to assert any resemblance between the human brain and a computer, there is a foundation provided for a computer to simulate human processes. Programs have been written which encompass elementary information processes. It is held, therefore, that there is no secret to problem solving because the complex structures of familiar simple elements can be simulated.

A second somewhat related hypothesis is that:

> Problem solving proceeds by erecting goals, detecting differences between the present situation and goal, finding in memory or by search tools or processes that are relevant to reducing differences of these particular kinds, and applying these tools or premises.[12]

This hypothesis is based on the work of Simon and the general problem solver program which was described in Chapter I.

> The limits of rationality derive from the inability of the human mind to bring to bear upon a single decision all the aspects of value, knowledge, and behavior that would be relevant. The pattern of human choice is often more nearly a stimulus-response pattern than a choice among alternatives.[13]

This hypothesis supplements the basic idea of acceptable choice rather than optimal choice. It further suggests that individual limitations may be overcome by having many people participate in the decision process. The great use of committees, boards and councils attests to the efforts of organizations to utilize specialized skills and diverse sources of information and experience in decision making. Because of the limitations of those on whom the decision rests, most information must be summarized. This process

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[12] Ibid., p. 27.

[13] Herbert A. Simon, Administrative Behavior (New York: The Macmillan Co., 1951), p. 108.

brings significant data to the decision maker, but on the other hand tends to filter out much information which may be essential to proper understanding. Group decision brings divergent views which must be reconciled. At times attempts at reconciliation generate disputes, power struggles, and even breakdowns of the decision-making process.

> The amount of search decreases with satisfaction, and clearly, if little search is going on, there is a strong tendency to persist in utilization of existing alternatives.[14]

There is a basic economic thought of diminishing utility and the psychological phenomenon of resistance to change hidden in this statement. Where a decision maker finds that all of his alternatives are not on a basis which permits comparison in order to choose the one which is preferable, or the consequences of each cannot be predicted, or the alternatives are otherwise unacceptable, then difficulty will be experienced in making a choice. In the case of uncertainty it is hypothesized that the first move will be to obtain more information about associated consequences. If this is not successful, then a search will be started for additional alternatives. Where the search fails to turn up an acceptable alternative, then less desirable alternatives may have to be accepted. In instances where the alternatives cannot be compared, the choice may depend on the decision maker's arbitrary responses and his sensitivity to the order in which the alternatives were examined.

> The possibilities for explaining decision-making behavior vary from the model of economic man who is highly rational, to a model called "heroic man."[15]

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[14]Morris, p. 461.

[15]Ibid., p. 463.

"Heroic man" may be the motivator of saints and soldiers. His ethic calls for action without calculation of the costs or consequences. One of the types which falls in the middle ground of limited rationality is "satisficing man."[16] This type is described as being concerned with whether a program is feasible and yields enough rather than if it is maximal. This view is understandable when considered in the limited rationality concept where man operates under conditions of incomplete information regarding his environment and his goals. "Timid man" and "bold man" are two additional types in the range that are distinguished by their relation to an organization.[17] With the tendency of modern organizations to expand formal controls, "timid man" finds comfort and safety for his decisions in regulations, instructions, and standard operating procedures. "Bold man," on the other hand, used the "book" as a guide and favors creative responses in order to short-cut problems. He relies to a great extent on his experience and professional judgment.

Summary

Decision theories may be categorized as normative, descriptive or optimal. The older theories stemmed from philosophy and emphasized logical thought processes. The descriptive theories of psychology, social psychology and sociology lay stress on the limits of rationality and the shortcomings of man's mind and knowledge of his environment and goals. Contemporary decision

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[16]Simon, Administrative Behavior, p. 47.

[17]Reitzel, p. 23.

theory is seeking optimal choice. Its development has been fostered by newer analytical techniques and the computer. Portions of three decision theories were presented.

Hypotheses, although more tentative and less complete than theories, have been developed to explain how man solves problems. They provide useful ideas of things and relationships to look for in decision-making situations. The possibilities for explaining decision-making behavior range from "economic man" to "heroic man." In the middle range of rationality are "satisficing man," "timid man," and "bold man."

Decision theories and hypotheses provide a framework for the many decision-making methodologies which have been devised. These will be considered in the next chapter.

CHAPTER IV

DECISION MAKING METHODS

The literature on decision making is replete with forms, check lists and schemes which often have been developed from the previously mentioned theories and hypotheses. Nearly every author provides one which is designed not only to aid decision making as the particular author sees it, but also to elaborate on some aspect which he believes has been neglected. The fault with most of these forms is that they are often applied mechanically and by rote. Methods should be viewed as aids not ends in the decision-making process. Their place, and their limitations, may then be better understood.

Probably the first and simplest form of a decision-making method was furnished by Dewey. He offered only three stages:

> What is the problem:
> What are the alternatives?
> Which alternative is best?[1]

One of the most elaborate methods contains nine stages:

1. OBSERVATION:
   Assembling and analyzing your facts, eliminating opinions and impressions.
2. DEFINITION:
   Defining your basic problems.
3. PREPARATION:
   Gathering other pertinent data.

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[1] Dewey, How We Think, Chapter 8.

4. ANALYSIS:
   Breaking down the relevant material.
5. IDEATION:
   Piling up alternatives by way of ideas.
6. INCUBATION:
   Letting up, to invite illumination.
7. SYNTHESIS:
   Putting the pieces together.
8. EVALUATION:
   Judging the resultant ideas.
9. DEVELOPMENT:
   Planning the implementation of those ideas.[2]

For the purposes of this paper, and because there is much duplication and overlapping between many of the stages of the various decision-making methods, the stages of problem definition, data gathering, alternatives, evaluation of alternatives, and selection of a course of action will be discussed. This is done as a matter of convenience since it is obvious that these stages could be compressed or expanded to suit an individual's desires.

Problem Definition

Problem definition may have many facets depending upon circumstances, conditions and the type of problem being considered. Its importance as more than just a starting point has been indicated as follows:

> The split views of the Joint Chiefs of Staff are usually the target for most of the criticism directed at our defective strategy making. Actually, these splits are in the main symptoms of an ailment, not the ailment itself. They are most often specific cases arising from more fundamental issues which lie in the background of the day-to-day divergencies of the Joint Chiefs. Until a Secretary of Defense requires the Chiefs to identify the basic divergencies and to present them to him for decision, it will never be possible to avoid splits or rise above piecemeal

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[2]Lee H. Bristol, Jr., "The Creative Approach--Definition, Preparation and Analysis" (Fort Belvoir, Virginia: United States Army Management School, 1961), p. 49. A talk given in the Military Problem-Solving Seminar.

action in putting the Defense house in order.[3]

This statement reaches to the heart of problem definition: identification. A problem must be identified, not by its symptoms but by its causes. In this regard, Drucker has stated that symptomatic diagnosis--the method used by most managers--is no solution.[4] Instead he indicates that more time should be spent on problem definition, and that this is begun by finding the "critical factor."

> This is the element (or elements) in the situation that has to be changed before anything else can be changed, moved, acted upon.[5]

Isolation of the critical factor employs two subsidiary approaches from the principle of "virtual motion." The first approach assumes that nothing will change and asks: What will happen in time? The other approach projects backward and asks: What, that could have been done or left undone at the time this problem first appeared, would have materially affected the present situation? A second step in this view of problem definition is to determine the conditions for the solution in terms of organizational objectives. This necessitates not only a knowledge of the objectives or goals of a business but their prior establishment.

The words goals, objectives and purposes are used in this paper to indicate organizational raison d'etre. Because of their importance to the

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[3]Maxwell D. Taylor, The Uncertain Trumpet (New York: Harper and Brothers Publishers, 1960), p. 116.

[4]Drucker, The Practice of Management, p. 354.

[5]Ibid., p. 354.

entire process of decision making, they will be discussed as they affect the various stages of the process. One author has underlined the importance of goals to our nation by stating:

> We must understand the goals to which we as a nation aspire or we will not be able to create the resources to serve these goals.[6]

This statement points to the fact that efforts must be channeled in established directions if we are to solve vital problems.[7] Objectives serve to set the framework within which a problem is viewed. It is conceivable that two organizations with opposed objectives not only would react differently to the same conditions, but would take opposed views as to whether a problem situation existed. Decisions made at any level within an organization should be made in such manner as to advance the organization toward its objectives. Where objectives are not well established, or are in conflict, there will be differing views as to the seriousness of a problem situation. For the firm interested in making a profit, the secondary questions of immediate profit, long-run profit or a continuing rate of profit arise.

Before a problem can be defined, there must be an awareness of a problem situation. It has been characterized as problem sensitivity. It may be the difference between the successful executive and the "muddler." Problem sensitivity is included in a larger stage which Simon has termed "intelligence activity."[8] He refers to it as finding occasions for making a

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[6]James M. Gavin, War and Peace in the Space Age (New York: Harper and Brothers Publishers, 1958), Chapter 7.

[7]One method of determining whether a basic problem has been isolated is to ask the question: Why? The answer should lead toward a particular objective.

[8]Simon, The New Science of Management Decision, p. 2.

decision and states that executives spend a large fraction of their time surveying the economic, technical, political, and social environment to identify new conditions that call for new actions.

Finally it should be recognized that all problems do not require decisions. Drucker has suggested that effectiveness is hampered by spending time on unproductive decisions.[9] He cites the example of status conflicts where there is no right decision. In such instances it would seem unwise to attempt any detailed problem definition. Further, it should be noted that a problem requires solution only when there is a demand for a changed situation or resistance against threatened change.

A bridge to the next stage of data gathering is provided by Tead:

> One has to identify carefully the problem to be solved. One has to become steeped in all the factual data and their implications.[10]

Data Gathering

This stage in the decision-making process may be the most expensive and time consuming. It is for this reason that many problems become stalled at this stage. Where it is obvious that the costs of collecting data will far exceed the benefits of a right decision or the disadvantages attendant to a wrong decision, prudence would dictate that a minimum of information should be assembled and a decision made accordingly.

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[9]Peter Drucker, "How to Become an Effective Executive," Nation's Business (April, 1961).

[10]Ordway Tead, The Art of Leadership (New York: McGraw-Hill Book Co., 1935), p. 132.

Sources of data may be classified as internal and external. Some of the standard and useful sources of internal data are:

1. Accounting records and reports.
2. Sales records, invoices and salesman's reports.
3. Production control records.
4. Material control and inventory records.
5. Quality control records.
6. Shipping department records.
7. Receiving reports.
8. Management engineering and time study reports and standards.
9. Personnel records.
10. Reports and records of meetings of committees, boards and other groups.

In using any of the above reports or records certain questions should be asked to ascertain the validity and usefulness of the data:

1. Are conditions under which the data were recorded clearly understood? Productivity during a period when a new product is introduced may differ markedly after production has been underway for some time.

2. Can a sample of the information be used rather than a complete study of all available data?

3. If data are not available, can a system for recording in the future be established?

4. Are the data being recorded so as to achieve something like a reasonable balance between storage cost and retrieval cost or access time?

5. If the exact information is not available, is there some way of inferring from it what is available?

The foregoing questions assume skillful analysis in selecting pertinent information. Where a sample of data are selected, these should be taken at random as in a probability sample in order that the sampling error may be predicted. Establishing a system for recording data would be done only where there would be a real and continuing need.

External sources of information are those outside the purview of the organization requiring the data. These sources are too numerous to mention but may be classified as follows:

1. Published information. Books, periodicals, reports, technical directories, trade journals, state and federal government publications.

2. Information available on request. Supplies, customers, banks, universities, government agencies, Chambers of Commerce, and even competitors.

3. Research and Development. This means that special efforts must be made to generate the information, possibly in a joint venture with another organization or by using outside assistance. It is expensive and not always successful.

Alternatives

Developing alternative courses of action is not an easy task. Many factors account for restrictions on this effort to the detriment of finding the best possible alternative. The range of alternatives considered may be severely limited by individual or collective resistance to change by the decision makers resulting from tradition or ego involvement. There there are

pressure of time and other factors on the decision maker, it is less likely that an exhaustive list of alternatives will be prepared. Well established and accepted policies often forestall any thought of other alternatives. Another factor which operates as a constraint on alternatives is investment. Where funds have been committed or expended for a project, it is difficult, and sometimes impracticable, to consider an alternative which will make a previous decision look bad.

> Most human decision making, whether organizational or individual, is concerned with the discovery and selection of satisfactory alternatives; only in exceptional cases is it concerned with the discovery and selection of optimal alternatives.[11]

This hypothesis is supported by many of the reasons listed above.

If it is granted that in many instances an active search for alternatives is not performed, the question of how long should search continue is raised. One author offers two principles in answer:

> (a) Continue search until the marginal cost of discovering an additional alternative is greater than the marginal gain to be derived from it.
> (b) Search only until an alternative is discovered which is acceptable. This simply requires a determination of the characteristics of an acceptable alternative in advance.[12]

The first principle lacks direct application. If marginal costs were readily measured, the economists' theories of marginal costs would have been found to be more practicable. Further, without knowing the value of the next alternative found, it is difficult to determine whether it is worth the cost

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[11] J. G. March and Herbert A. Simon, Organizations (New York: John Wiley and Sons, Inc., 1958), p. 136.

[12] Ibid., ibid., pp. 77-78.

of discovery. The second principle provides little improvement over present practice. It does require qualification if an acceptable alternative information is other than the decision-maker has a better idea of what he is looking for. It would that the only answer to the extent of which may be that the decision-maker should spend as much time and energy as he finds are appropriate to the problem and consistent with existing conditions and pressures, while being aware of the factors which may restrict his viewpoint or could so prevent a problem from being thought through.

The search for alternatives may be conducted by a number of means. It may be systematic, in terms of a plan for investigating various sources of information; or it may be random, to the extent of scanning about for information. Creative thinking as a means of finding alternatives has been resolving problems attention for a number of years. A distinguished psychologist has said:

> There are certain stages in most problem solving where there must be a searching for answers. The problem as stated or defined provides the specifications for the solutions that are sought. Unless the specifications point to a unique solution upon searching and scanning, if alternative solutions is likely to occur. The scanning process is more likely to arrive at suitable solutions if it can elicit a greater number of possibilities. This ideational fluency probably plays an important role in problem solving, and many problems require novel solutions, which means creative thinking.[1]

Creative thinking may seem to be a talent which you must be born with. This is not the case.

> I am convinced that many executives can also increase their creative ability, as indeed, most businessmen have the intelligence to learn how to create. This is not to say that all men can become

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[1]Anderson, Creativity and Its Cultivation, p. 147.

> ...ually creative, but by learning an understanding of the creative process and deliberately putting it to work, a man can augment whatever creative ability he may have.[14]

An operative definition of the creative thinking process is:

> Creative thinking is the process of bringing a problem before one's mind clearly as by imagining, visualizing, supposing, musing, contemplating, or the like, and then originating or inventing an idea, concept, realization, or picture along new or unconventional lines. It involves study and reflection rather than action.[15]

Some of the considerations important to the creative thinking process are that an idea consists of known elements and that the secret of creativity is curiosity about the universe. A positive attitude toward complete freedom of ideas is equally important and has been stressed by numerous authors. Osborn refers to it as the "deferment of judgment principle."[16]

One technique for stimulating the search for alternatives is to use a form of self-interrogation. It is similar in some respects to the type of questions asked by management engineers and industrial engineers for work simplification. The technique consists of the following questions:

> PUT TO OTHER USES? New ways to use as is? Other uses if modified?
>
> ADAPT? What else is like this? What other idea does this suggest? Does past offer parallel? What could I copy? Whom could I emulate?
>
> MODIFY? New twist? (adj.) Change meaning, color, motion, sound, odor, form, shape? Other changes?
>
> MAGNIFY? What to add? More time? Greater frequency? Stronger? Higher? Longer? Thicker? Extra value? Plus ingredient? Duplicate? Multiply? Exaggerate?
>
> MINIFY? What to subtract? Smaller? Condensed? Miniature? Lower? Shorter? Lighter? Omit? Streamline? Split up? Understate?

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[14]Stanley H. Jones, Executive Decision Making (Homewood, Illinois: Richard D. Irwin, Inc., 1957), p. 35.

[15]John F. Mee, "The Creative Thinking Process," Indiana Business Review, Vol. XXXI, No. 1 (February 1956), p. 3.

[16]Alex F. Osborn, "Principles and Procedures of Creative Thinking--Recent Developments," Military Creative Problem-Solving Seminar, Fort Belvoir, Virginia: U. S. Army Management School, 1961, p. 14.

SUBSTITUTE? Who else instead? What else instead? Other ingredient? Other material? Other process? Other power? Other place? Other approach? Other tone of voice?

REARRANGE? Interchange components? Other pattern? Other layout? Other sequence? Transpose cause and effect? Change pace? Change schedule?

REVERSE? Transpose positive and negative? How about opposites? Turn it backwards? Turn it upside down? Reverse roles? Change shoes? Turn tables? Turn other cheek?

COMBINE? How about a blend, an alloy, an assortment, an ensemble? Combine units? Combine purposes? Combine appeals? Combine ideas?[17]

Group techniques for discovering alternatives include "brainstorming" and "buzz groups."[18] "Brainstorming" lends itself to problems of product development or improvement. The purpose is to create a mood for the free flow of ideas. The rules of "brainstorming" are: (a) "judicial thinking" is not permitted, (b) suggestions are encouraged and none are regarded as being ridiculous, (c) a great quantity of suggestions are desired on the premise that quantity breeds quality and the best ideas seldom come first. Advocates of "brainstorming" believe that the group process produces more ideas than individuals working alone since each idea expressed may suggest a similar or related idea to another person.

"Buzz groups" have been found effective for large groups of 40 or more who are attempting to discuss a complex problem. In order to get the benefit of everyone's ideas and to promote participation, the large group is broken into small groups not exceeding eight members. Each of the "buzz groups" is given a limited specific question, which is a part of the larger

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[17]Alex Osborn, Applied Imagination (New York: Charles Scribner's Sons, 1953), p. 284.

[18]"Brainstorming" is a technique invented by Alex Osborn and described in Applied Imagination. "Buzz groups" were originally developed by J. Donald Phillips. See J. Donald Phillips, "Report on Dimension 66," Adult Education Journal (7, 1948), pp. 181-182.

problem, to consider. At the end of about ten minutes a spokesman designated by each of the "base groups" reports on the question to the entire meeting. One of the prime values of this method is that each participant is required to give special attention to a phase of the complex problem and to commit himself orally.

Evaluation of Alternatives

The "scientific method" of looking at alternatives is to apply some measurement of value to the predicted outcomes. In so doing the outcomes or consequences may then be evaluated in terms of the extent to which they advance an organization toward its objectives. This, as has been previously noted, not only requires that objectives be formulated and published but that a relative ranking be assigned to them.

Value measurement of outcomes in evaluating alternatives requires more analytical effort than any other phase of the decision-making process. One of the most difficult problems, which is not always surmountable, is that some alternatives do not have a common basis for comparison. The decision maker may then find himself facing obtuse choices similar to those posed by the facetious question: "Would you rather walk to work or buy your lunch?" Business organizations usually evaluate outcomes in cost or profit terms based on historical accounting data and its projection. However, all alternatives cannot be precisely evaluated in these terms, particularly where alternatives which affect objectives such as good will, job satisfaction, safety, and other intangibles are concerned. The ultimate aim of the analyst

is, nevertheless, to develop objective methods of evaluating intangibles. In this regard, one author says:

> The reader should be warned that this is not only the most important part of the analysis of decision, but also the most difficult and most primitive with respect to scientific development. Indeed, some people believe that science can never make much of a contribution to the problem, while others strongly disagree.[19]

In one study of a business decision it was found that the evaluation of alternatives is a crude process.[20] In some situations a choice was made between competing alternatives while in others it was a matter of accepting or rejecting a single course of action. Some choices were made on the basis of relative costs and savings while subsequent related choices were based entirely on nonmonetary criteria. In evaluating consequences, attention seemed to focus on the feasibility of alternatives where feasibility meant: (1) Is the money available for the alternative? (2) Is it clearly better than the existing method?

The literature on decision making is generally rather vague on methods of evaluating alternatives. In more recent years it has been customary to state that evaluation is assisted by methods and techniques such as economic forecasting, market projections, linear programming and game theory.[21] One method of weighing the alternatives involves six steps. These are:

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[19] Roland N. McKean, Efficiency in Government through Systems Analysis (New York: John Wiley and Sons, Inc., 1958), p. 74.

[20] Richard M. Cyert, Herbert A. Simon, and Donald B. Trow, "Observation of a Business Decision," Journal of Business, XXIX, 4 (1956), pp. 237-248.

[21] These newer analytical techniques and theoretical approaches will be discussed in Chapter VI.

1. Uncover the premises germane to each alternative. (Premises are defined as statements containing a description of both cause and result which are deemed pertinent to the alternative being examined.)

2. Separate the premises pertaining to each alternative according to whether they point to a desirable or undesirable effect in achieving stated goals.

3. Check the validity of what would occur in case an alternative were adopted. This involves determining whether the validity is measured by a factual characteristic, an objective or agreed upon measuring rod; or by a value characteristic, which is a subjective and personal standard.

4. Test the validity of the salient premises.

5. Weigh the premises pertaining to each alternative with a view toward ascertaining which ones will have the greatest impact on desired goals.

6. Determine which alternative will provide the greatest total amount of wanted results and the least amount of unwanted results.[22]

These six steps provide a more rational method of evaluating alternatives than judgment based on experience. Whether they will lead to proper evaluation may depend upon the degree of uncertainty involved in each alternative and the relative weights or rankings that are assigned. Evaluation may be summed up by the statement:

> Decision making implies that there are alternative actions. In fact to make no decision is a decision in itself. . . . The probable outcome of any decision usually receives much consideration. An attempt is made to predict consequences and then make the decision that apparently will result in the events that are judged best for the organization.[23]

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[22]Jones, Executive Decision Making, pp. 33-34.

[23]Carroll L. Shartle, Executive Performance and Leadership (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1956), pp. 282-283.

Selection of a Course of Action

This step in the process popularly receives the most attention because it is the final moment in the decision-making process. It is the step, however, on which the least amount of time is required if the previous steps have been properly performed.

When an executive makes a decision, there are usually a variety of courses of action available to him. However, others in an organization have made decisions which influence the available courses of action. Often this occurs to the point that the decision maker has only one logical course of decision. The question then arises: Who has made the decision? This concern was voiced many years ago:

> So much goes to contribute to executive decisions before the part which the executive head takes in them, which is indeed sometimes merely the official promulgation of a decision, that the conception of final authority is losing its force in the present organization of business.[24]

And similarly:

> An executive decision is a moment in a process. The growth of a decision, the accumulation of authority, not the final step, is what we need most to study.[25]

The executive or manager does of course have the right to say yes or no to any proposed alternative. This involves more than appears at first glance, particularly when it is realized that:

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[24]Mary P. Follett, "The Illusion of Final Authority," a paper presented by Mary Follett at a meeting of the "Taylor Society" (now the "Society for the Advancement of Management") in New York, December 10, 1926.

[25]Ibid.

> The fine art of executive decision consists in not deciding questions that are not now pertinent, in not deciding prematurely, in not making decisions that cannot be made effective, and in not making decisions that others should make.[26]

This statement suggests that decisions are not always made logically on cold facts and pure reasoning. A similar view has stated that among the other factors which must be considered are: the personal desires and goals of subordinates, the conflict of personal and company goals, timing, and the knowledge of when to be prompt and when to be deliberate. This view further states that an executive must take risks courageously, without evasion, and decide what considerations are the most important.[27]

While rational decision making may be sought, the selection of a course of action remains much of an art.

It should be further noted that the steps in decision making are not always followed in the sequence in which they have been presented. There is often much back-tracking and, depending on the situation, certain of the beginning and intermediate steps may receive no consideration whatsoever.

Summary

Various decision methods containing from three to nine or more stages have been devised. All of the methods contain the basic stages of problem definition, alternatives, and evaluation of alternatives. In this paper a second state of data gathering and a final stage of selection of a course of action have been discussed in addition to the three primary stages.

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[26]Barnard, The Functions of the Executive, p. 192.

[27]Perrin Stryker, "How an Executive Makes Up His Mind," Fortune (April, 1960), p. 114.

Objectives, purposes or goals must be kept in mind when applying a decision method. Objectives are particularly important to the framing of problem definition and the consideration of alternatives.

In any decision method it should be remembered that methodology should not be utilized mechanically or by rote. Decision methods are aids not ends to facilitate thinking a problem through to a decision. In problem definition it is important to seek the cause of a problem rather than deal with a symptom. Asking the question "why?" often helps to determine whether a problem has been isolated so that the problem solution will lead toward attainment of an objective. The second stage, data gathering, is perhaps the most time consuming and expensive step in the decision process. Probability sampling is a useful tool in providing meaningful statistics which describe characteristics of a problem at lesser costs. An understanding of creativity will speed the search for alternatives, the third stage. Some of the techniques used in finding alternatives are check-lists, "brainstorming" and "buzz groups." The fourth stage, evaluation of alternatives, is the most difficult analytical step. An adequate method of comparing alternatives which involve intangibles has not been discovered. Part of the difficulty stems from organizational inability precisely to establish objectives and to determine their relative precedence in particular problems. In evaluating alternatives an effort should be made to differentiate "fact" and "value" considerations. Selection of a course of action, the fifth stage, is the least time consuming act. Its practice, however, is more of an art than a science.

CHAPTER V

GROUP DECISION MAKING

There have been previous references to group decision making and some of the group techniques which may be applied. In general, however, previous chapters have emphasized decision making by individuals. Our democratic society places great importance on wise group decisions. It is important to understand then how the federal government and business and industry make decisions in the group environment.

Group management has increased tremendously since the 1900's. It has been explained as follows:

> As soon as a manager is forced by the growth of his company, the variety or complexity of its products, or the simple geographic separation of its plants to establish broad policies, chart high strategy, and review operations--then the manager finds himself in conference with his peers.[1]

Organizations are the answer for problems too complex to be handled by one individual. This stems from the limited memory, short span of attention, and overall physical limitations of one person to consider, decide and communicate on a myriad of large and small problems. Consequently, organization by function has been the basic method to (1) break down problems into component parts, (2) to assign the responsibility for dealing with the

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[1]Harryman Maurer, "Management by Committee," Fortune (April, 1953), pp. 145-147.

segments to various levels and specialized units, and (3) to coordinate these separated efforts in a process of organizational decision and action.[2]

With the growth of organizations and the complexity of problems it has been necessary to utilize boards, councils and committees to accomplish the coordination function. Discussion, the primary medium of groups, has been defined:

> Discussion is oral, involves a group, involves interaction, is purposeful, and proceeds systematically. Members must accept group orientation--consider what is in the best interest of all or most members. Methods and ends considered appropriate are determined by the attitudes, values, and objectives of the group.[3]

Group Decision Continuum

Problem solving discussion is a phase of a larger process, deliberation. It may be represented by a continuum similar to the one described in the previous chapter on Decision Making Methods:

Problem.

Definition.

Analysis.

Suggested Alternatives.

Weighing of Alternatives.

Decision.

The deliberation continuum would be complete if decision could be reached through this discussion process. This is not the case. It must be recognized

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[2]Seitzel, Background for Decision Making, p. 140.

[3]Halbert E. Gulley, Discussion, Conference and Group Process (New York: Henry Holt and Co., 1960), p. 6.

that reasonable men will differ in their perception of a situation, its significance, and suggested solutions.[4] Once proponents of particular proposals become so convinced that only their solution is proper, they become advocates of their cause. At this point discussion has ceased and debate began. The debater has renounced group orientation and has undertaken the task of persuading the group to his view. This change is one of attitude or objective, since the debater is no longer concerned with the group effort to reach a decision acceptable to most if not all of the group.

Where debate enters the group-decision process, the deliberation continuum then appears as follows:

Problem
Definition
Analysis
Suggested Alternatives
Weighing of Alternatives
Decision (Impossible)
. . . . . .
Advocacy on Alternatives
. . . . . .
(Possible return to discussion)
(Possible vote)
Decision[5]

All discussions, however, are not undertaken with the purpose of reaching an immediate decision either by discussion or deliberation. In many instances discussions serve only to keep members apprised of current happenings, or to permit some speculation of their impact. In general, it may be used to promote situation awareness. This type of discussion is

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[4]In one particular instance, the Armed Services Procurement Regulation (ASPR) Committee's instructions given to subcommittee members recognize that there will be honest differences of opinion. In order to have the benefit of divergent views, the ASPR Committee provides for the submission of minority views from subcommittees.

[5]Gulley, Discussion, Conference and Group Process, p. 12.

exemplified by a description of the President's weekly Cabinet meetings:

> These discussions, at best, bring out useful information and opinions, clarify the issues, and promote morale among the top executives of the Administration. Almost never do they culminate in decisions on policy by mere show of hands.[6]

Advantages of Group Decisions

A number of advantages are claimed for group action. It is maintained that there is a stronger commitment to decision when those affected have participated in its formulation. While a single executive can make a decision, rarely can he carry it out alone. Others must translate it into action. This translation is expedited, not only because the circumstances and background considerations are better understood but because those charged with implementation are more involved in the decision. They are, therefore, usually more willing to do the necessary work involved in the execution of a decision to make it a success. A similar view was expressed last fall:

> An employee's participation in decision making and his right to question company rules are essential in creating a healthier organization, states L. A. Peterson, Board Chairman of Otis Elevator Company, New York, in Industrial Relations News.[7]

The McCormick Multiple Management Plan is one of the outstanding examples of finding success through the participation of employees in management.[8] The plan operates through a combination of auxiliary management

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[6]William H. Young, Ogg and Ray's Introduction to American Government (New York: Appleton-Century-Crofts, Inc., 1936), p. 331.

[7]_____, Management Review (American Management Association, Nov., 1951), p. 18.

[8]Charles P. McCormick, The Power of the People (New York: Harper and Brothers Publishers, 1940), p. 17.

boards, participation, sponsorship, merit-rating and two-way communication between all employees and management. Many improvements and innovations have resulted from the plan.

It is believed that groups produce better quality decisions than individuals working separately. Group decisions characterize the operations of many large corporations, such as General Motors. Most of these committees are composed of specialists representing different areas of knowledge along with general officers who represent the corporation as a whole. Each presents data with opinions and some measurement. A top executive or the group must then sort out the fact and value premises of the various alternatives and decide on a particular course of action.[9] Group decisions may also be improved by other considerations, such as:

> (1) social influence of others in the group,
> (2) motivation to complete a task successfully may be different in the presence of others,
> (3) necessity for communicating may result in "sharpening and refining" of ideas,
> (4) individual proposals, being subjected to processes of "compliance, concession, compromise and rejection" are thereby "combined and mingled" in a complicated way in arriving at the group product.[10]

Some Group Decision Inconsistencies

The speculative advantages of group decisions are similar to those which may account for the behavior of a decisional unit. In one study the hypothesis was advanced that spheres of competence, communication and

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[9]John McDonald, "How Businessmen Make Decisions," Fortune (August, 1955), p. 75.

[10]Bailey, Discussion, Conference and Group Process, p. 69.

information, and motivation account for the behavior of a political unit.[11] This hypothesis led to the formulation of a number of propositions regarding decision making in the U. S. House of Representatives Rules Committee.[12] These propositions are:

Proposition 1.1 When the spheres of competence of a decisional unit are not explicitly or completely prescribed, individual members of the unit are required to interpret their competences for themselves.

Proposition 1.2 When spheres of competence are not clearly defined, diverse loyalties compete for an individual's allegiance.

Propositions 2.1 and 3.1 A decision maker interprets his competence in terms of his information and motivation.

Proposition 2.2 The greater the prestige of and respect for the sender, the greater is the impact of the information on the recipient.

Proposition 2.3 In any organization, an informal communications network grows up around the formal structure.

Proposition 2.4 The less the flow of information from system sources, the more reliance will be placed on information within the decisional unit.

Proposition 2.5 The greater the dependence on information within the decisional unit, the more relevant is the previous experience of the decision maker.

Proposition 2.6 The shorter the period for decision, the less thorough the search for information.

Proposition 2.7 There is a point beyond which further consideration will not yield additional information.

Proposition 3.2 The values and objectives that guide individual decisions in organizations include organizational values and objectives.

Proposition 3.3 The values and objectives that guide an individual's decisions in organizations include his previous life experience or social background.

Proposition 3.4 Organizational values and objectives may conflict with non-organizational values and objectives.

Proposition 3.5 Resolution of conflicts between organizational and non-organizational values depends on one's estimate of the strength of the competing demands.

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[11] H. W. Bruck and Burton Sapin, "Decision Making as an Approach to the Study of International Politics," (Princeton, New Jersey, 1954).

[12] James A. Robinson, "Decision Making in the House Rules Committee," Administrative Science Quarterly (June, 1958), pp. 473-493.

These propositions, although based on a governmental political unit, contain some interesting concepts regarding group decision making. Some of the propositions may seem to be elaboration of the obvious. However, it has often been shown that the obvious is not as obvious as was first supposed or that the obvious does not agree with the facts on which the obvious was assumed. In these propositions, it appears that the individual members of the House Rules Committee receive little instruction and are subjected to various pressures from larger groups within the organization. Communication channels are crucial to a member's competence, and his strongest motivations are to comply with the wishes of his party's leadership. Members are influenced by "who" sent the information and the "word" is usually received from the party leadership by informal communications. Where information is not received from any information channel, members must rely on their own experiences, inferences from similar events, and their own values and motivations. This factor of dependence may permit prediction of a member's behavior if enough is known about the member's background, education, experience, attitudes, etc. Hearings held over several days revealed that there was a point at which no additional information was obtained, only repetitious questions and answers. Organizational values are predominantly in the area of cooperation. A pungent epigram attributed to the late Speaker Rayburn is: "To get along, go along." In resolving conflicts between organizational and nonorganizational values, survival is valued more than a single vote.

Whether these propositions are completely applicable to business and industry or the military services need not be argued here. They do provide some indication of the significance of spheres of competence, information and motivation in group decisions. As such they permit greater insight into the business of group decision making.

The large sources of variables are said to account for interaction and the tendencies of groups. These are (1) personal variables and (2) group properties and situational variables.[13] Personal variables are:

(a) The amount of relevant information each person possesses and his access to pertinent materials.

(b) Each person's ability to reason.

(c) Each person's articulation--his skill in using language and communication.

(d) Each person's ethical standards.

(e) The extent to which each person tends to be dominant or submissive, kind or unkind, tactful or unstactful.

Group properties and situational variables which affect interaction are:

(a) The type of group.

(b) The nature of the group's task or goals.

(c) The time available for the discussion.

(d) Physical arrangements, including placement of members.

(e) Group norm or standards.

(f) Type of leadership and the extent of group acceptance of the leadership.

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[13]Culley, Discussion, Conference and Group Process, pp. 31-32.

All of these personal and group properties are variables. Consequently, generalities cannot be made about every discussion situation involving every type of person.

Disadvantages of Group Decisions

There are numerous disadvantages of group decision making. Its use should therefore be restricted to situations where these disadvantages will not be encountered or where preparations have been made to minimize these disadvantages. First, discussion is always time consuming. Each member is desirous of having his "say." In most cases there are no short cuts to avoid this occurrence, and it is often necessary to full and complete understanding. Further, many persons feel they must make an impression, on their boss or others, even if they only offer in different form what may have already been said. Second, discussion is often wasteful. There are usually false starts and many unproductive explorations. After much discussion it is sometimes discovered that the group has no authority to do anything about a particular problem, or that an answer is neither needed nor desired. Third, discussion can after a point become a substitute for action. Calling meetings and attending them can become an addiction with some people such that other duties are severely neglected. Fourth, discussion can be indecisive. Responsibility for action may be so vague that no one member can be singled out as the cause of the delay. In other situations two opposing views may split the group to the detriment of any sort of unity of action. Finally, the group may be so constituted that some members will not speak because of social or status

pressures and fear of disapproval. Helpful criticisms and valid objections, which may come to light after a plan is executed, are withheld when most needed.

Relationship of Group Decision Making to the Organization

Within an organization there are various levels of individuals and groups who are engaged in various stages of the decision-making process. At the lower levels, policies and higher level instructions enable groups and individuals to make decisions within the frame of reference supplied them. Policies usually are formulated to provide guidance for repetitive situations that have previously occurred and are likely to happen again in the future. Where nonprogrammed situations arise, it may happen that the problem is passed to the hierarchy of an organization for decision.

Chart 1 shows a model cycle of organizational operation.[14] The upward steps here of raw information, processed information, professional judgment, advice and recommendations roughly correspond with those described in decision-making methods. The downward steps are those concerned in the execution of a decision. It should be noted that the logical starting point is the situation. However, information sometimes reveals a situation, action in one situation may sometimes create another, etc. Within an organization the various steps are most often performed by individuals who comprise functional groups for the stated purposes.

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[14]Heitzel, Background to Decision Making, p. 29.

MODEL CYCLE OF ORGANIZATIONAL OPERATION

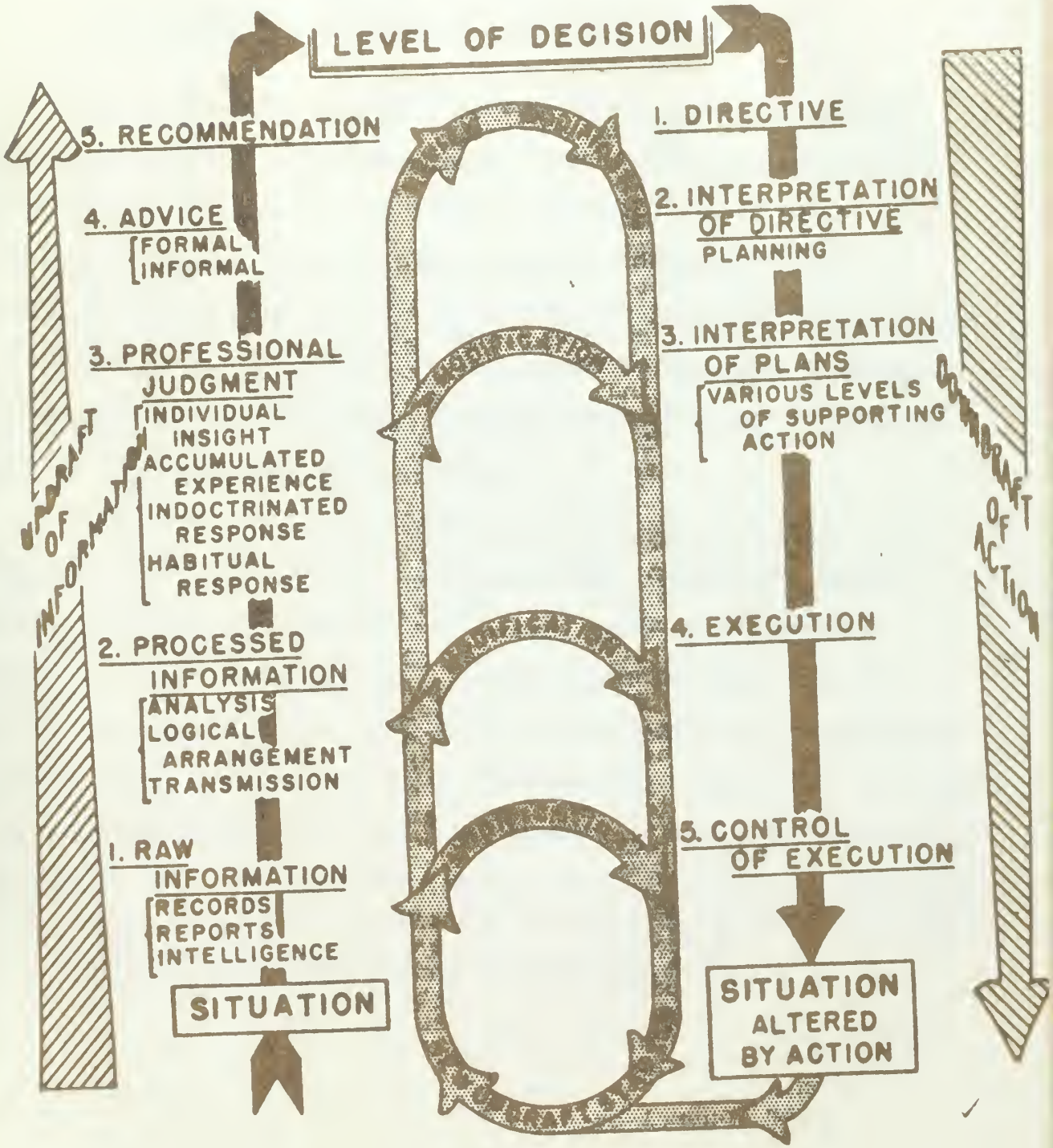

CHART I

CHAPTER VI

NEW ANALYTICAL TECHNIQUES AND THEORETICAL APPROACHES

The new analytical techniques and theoretical approaches exemplify practical applications of decision theory. Most of the new techniques have been introduced under the name "operations research." Some of these techniques are linear programming, queing theory, probability theory, communication theory, and game theory. Providing the principal impetus behind most of these techniques and theories is the giant of this age, the computer. This chapter will review the strengths and weaknesses of these new techniques and their contributions to decision making.

It was previously observed that decisions may be programmed to the extent that they are repetitive, routine and definite procedures, usually policies and higher level instructions have been provided as a frame of reference. Where decisions are unique, novel, or consequential they are referred to as nonprogrammed. Chart 2 contrasts programmed and nonprogrammed decisions in the traditional and modern decision-making techniques.[1] The chart is self-explanatory with the possible exception of "heuristic problem-solving techniques." This refers to discovering how our mental processes function and

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[1]Simon, The New Science of Management Decision, p. 8.

CHART 3

Types of Decisions	Decision-Making Techniques	
	Traditional	Modern
Programmed: Routine, repetitive decisions. Organization develops specific processes for handling them.	1. Habit 2. Clerical routine: Standard operating procedures. 3. Organizational structure: Common expectations. A system of subgoals. Well-defined informational channels.	1. Operations research: Mathematical Analysis Models Computer simulation 2. Electronic data processing
Nonprogrammed: One shot, ill-structured novel policy decisions. Handled by general problem-solving processes.	1. Judgment, intuition, and creativity. 2. Rules of thumb. 3. Selection and training of executives.	Heuristic problem-solving techniques applied to: (a) Training human decision makers. (b) Constructing heuristic computer programs.

using the information about these processes so that we can teach a man or a machine what he has to notice and how he has to proceed in order to solve problems relating to various subjects.[2] An understanding of the types of problems to which operations research is being applied provides a better understanding of the utility of this technique.

Operations Research

Various definitions of operations research are available. One of the more comprehensive definitions states that the characteristics of operations research are:

> (a) Research on the overall aspects of an action system, as opposed to parts.
> (b) Optimization of operations to obtain greater assurance of both short and long range advantages for an organization.
> (c) Application of the newest scientific methods and techniques such as linear programming, game theory and information theory.
> (d) Synthesis and extension of the methods and techniques of the older management sciences.
> (e) Development and use of analytical models in the manner common to the basic sciences.
> (f) Design and use of experimental operations that give an insight into the behavior of actual operations.
> (g) Use of integrated and creative multi-disciplinary research to solve complex operational problems.[3]

These characteristics require some additional explanation. First, operations are considered as an entity. "The subject matter studied is not the equipment used, nor the morale of the participants nor the physical properties of the output; it is the combination of these in total, as an

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[2] A description of some of this work was provided in Chapter I, A Joint Contribution.

[3] _____, Operations Research for Management, Edited by Joseph F. McCloskey and Florence N. Trefethen (Baltimore, Maryland: The Johns Hopkins Press, 1954), p. xi.

economic process."[4] This concept of operations has led to the "system approach." It means designing the components of a system and making individual decisions within it in the light of the implication of these decisions for the system as a whole.[5]

In terms of research, there are those who feel the "research" is nothing more than the tools of systematic, logical and mathematical analysis and synthesis.[6] Such a definition identifies operations research with the application of scientific method to management problems. Consequently, it would appear that except in the matter of degree and the application of advanced mathematics, Frederick Taylor in his "scientific management" was using the same philosophy. A prime difference in more recent years has been the emphasis on the multidisciplinary approach and the contributions of the "behavorial sciences."

In applying the scientific method, emphasis is placed on the analysis of data. This step follows previous steps of: (1) observation and general survey of the problem area, (2) definition of the problem, and (3) fact finding. In analysis, emphasis is placed on:

(1) The classification of data.
(2) The isolation of patterns or trends.
(3) The determination of cause and effect relationships.[7]

This step is followed by the construction of a model which functionally relates the critical variables to given patterns of interaction. Three kinds of models may be built:

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[4]Cyril C. Herrmann and John F. Magee, "Operations Research for Management," Harvard Business Review, XXXI, 4 (1953), p. 101.

[5]C. West Churchman, Russel L. Ackoff and E. Leonard Arnoff, Introduction to Operations Research (New York: John Wiley and Sons, Inc., 1957), pp. 109-111.

[6]Drucker, p. 366.

[7]Clifford J. Craft and David B. Hertz, Systems and Procedures, Edited by Vincent Lasseno (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959), p. 407.

(1) Iconic - a literal pictorial representation of certain aspects which are subject to metric transformation. Examples are model cars or airplanes built to scale.

(2) Analogue - things are used to stand for and represent other things. Water flowing through a pipe is analogous to electricity coursing through wires.

(3) Symbolic - symbols are used to stand for some other property such as mathematical equations or inequations. These models have a close tie to digital computers because of the elements of uncertainty and their reliance on probability theory.[6]

While all three models could be used as one, it is unusual for operations research to employ iconic models. In solving symbolic models there are three methods:

(1) The use of mathematical decision analysis and analytical procedures.

(2) Resorting to numerical procedures and the process of iteration (counting). In so doing, trial and error is employed and approximations are made to get closer and closer to the answer.

(3) "Monte Carlo" technique. It is distinguished from (2) because it involves stochastic variables. These identify a selection from events and can be expressed only as probability functions--a series of dependencies--in which the outcomes are dependent one on the other in terms of probability.

One of the primary advantages of a computer is its large memory. Where the machine contains both status data and the laws which describe the system's behavior, the machine can make predictions. This ability enables the computer to be used extensively in engineering and the physical sciences

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[6] L. F. Erickson, lecture to the Navy Financial Management Class, Dec. 19, 1961.

to study the behavior of complex systems where the individual elements of the problem and their interactions can be understood and represented in a simple way, but where the behavior of the whole system involves so many simultaneous interactions that the human mind cannot grasp the whole.[9] This leads to the question of models and understanding. A simple model that can be understood conceptually provides insight into the problem of bringing out the relations between inputs or assumptions on one hand and results on the other. It possesses the disadvantage that the problem is oversimplified and lacks realistic detail. A big detailed model will provide little conceptual insight. It will contain a large number of assumptions (many of which are highly conjectural) and the relationships between input and output will not be well understood. In these elaborate simulations there is the danger that an executive may depend on computerized decision aids without realizing how much human judgment has gone into making such aids useful to him. The defenders of big detailed models state that simulation should not be expected to give precise predictions. Rather its value is heuristic and educational. If this is so, it would seem that the proper procedure may be to build a simple model and gradually add detail as understanding develops.[10]

Essential to the mathematical logic of the model is a consistent statement of the objectives of the operation.[11] Operations research can be applied to a situation and predict consequences of various alternative courses

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[9]Thornton Read, Command and Control, Policy Memorandum No. 24 (Princeton University: Center of International Studies, 1960), p. 6.

[10]Read, p. 8.

[11]The importance of objectives was similarly mentioned in Chapter IV, Decision Making Methods.

of action. The alternatives depend, however, on the specification of various objectives, and on the manipulation of different single variable factors. Under such conditions operations research clarifies the alternatives available for various sets of circumstances and purposes. The act of decision remains a responsible human choice.

It may be observed then that operations research works by seeking to identify irregularities in apparently random activities. This usually takes the form of giving mathematical expression to the patterns that underlie the operational process being studied. It seems unlikely that a machine can be programmed to find relations between the pieces and abstract from the details a useful pattern. The recognition of patterns must depend essentially on the human analyst who then builds a model. Computers perform the service role of data retrieval and testing the accuracy of the model.

For programmed decision making, operations research requires that:

> (1) The situation contain variable but related factors.
> (2) The situation must be repeatable.
> (3) A specific objective must be given, in terms of which the factors and their relationships can be manipulated.
> (4) Technique of solution is often one of juggling the factors in relation to one another to determine the relationships which will most efficiently produce the result desired.
> (5) To perform the analyses needed, the data must usually be expressed quantitatively.[12]

The operations research approach to problems can be a significant aid to the decision-making process in any organization. It permits analysis of problems and the clarification of alternatives. In so doing it indicates the reliability of data, the relationship between variables, the resources needed

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[12]Reitzel, p. 62.

for alternative actions, and predicts for each course of action its risks and probabilities. The new tools, operations research, do have limitations, which when recognized, remove much of the mystician that has been associated with the two miraculous sounding words: operations research. First, operations research provides tools to solve problems. It does not define the problem or even raise questions about it. Further, the objectives must be established and set out. Finally, the decision regarding the best solution must be selected by a human decision maker. These limitations will be observed in the techniques with which the researcher must be familiar.

Linear Programming

Linear programming is basically a mathematical method for analysing the relationship of variable but mutually dependent factors in order to find the best combination for a given purpose. It is a technique for determining the optimum way to use resources. It employs linear equations subject to limitations placed on the variables which are accurately known. Techniques of solution generally require high-speed computers. In industry linear programming has been applied to determining optimum solutions for planning and scheduling and for certain production and inventory problems.

Queing Theory

This is a method of analysis used where there is a lack of timing between arrival, at some point in an operation, of a sequence of units and the subsequent disposal of the units. Consequently a queue or waiting line is formed. The central problem is one of the relationship between the mean

length of the waiting line and the degree of randomness of arrival and disposal. A formula which shows the chance of having n units in a waiting line is:

$$P_n = (A/S)^n \; 1 - (A/S)$$

where: A = mean arrival rate

S = mean disposal rate (assumed larger than A)

Where both arrivals and departures are random the "Monte Carlo" method for solution is employed. It uses tables of random numbers and empirically determined probability distributions.[13]

Queing theory has found considerable use in staff planning. It was originally developed to solve certain problems in an automatic telephone switching system. Subsequently it has been applied to airline traffic and industry production problems.

Probability Theory

Probability theory was discussed as one of the contributions of statistics in Chapter II. Essentially it involves predictions of the likelihood of the occurrence of certain variables in various situations. Probability theory usually forms a significant part of many models. Its use in operations research is not only the relation between numbers, as in statistics, but to permit an understanding of the operation which the numbers represent. This is

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[13] "Monte Carlo" method was mentioned briefly in this chapter in connection with solutions to symbolic models.

done by predictions which contain uncertainty ranges. One of the more esoteric uses of probability has been in search analysis--the problem of locating things in a specified area or under specified conditions.

Sampling Theory

Sampling theory has also been previously mentioned. In operations research it is applied primarily to the data-gathering function. This mathematical technique offers an economical and effective way of obtaining statistics which provide reliable indications of the decision parameters for a universe of data. It is a very essential and useful tool.

Game Theory

This is one of the more recent techniques which is considered a major breakthrough in management science. It is a method for the study of decision making in situations of conflict where rivalistic behavior brings about strategic behavior. The theory of games is concerned with choosing among alternative courses of action. In so doing each opponent desires to obtain the maximum return while yielding only the minimum which an opponent forces. This has led to the minimax-maxima return concept.

> The individual has to work out how to achieve as much as possible, taking into account that there are others whose goals are different and whose actions have an effect on all. A decision maker in a game faces a cross-purposes maximization problem. He must plan for an optimum return, taking into account the possible actions of his opponents.[14]

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[14]Martin Shubik, "The Uses of Game Theory in Management Science," Selected Readings in Management, edited by Fremont A. Shull, Jr. (Homewood, Illinois: Richard D. Irlin, Inc., 1958), p. 157.

The theory is a mathematical demonstration that, if opposing forces act rationally to achieve their objectives, can be set forth in a numerical scale of expected returns (usually matrix form). Returns will vary according to the success of various alternatives when opposing an opponent's alternatives. In this form the appropriate strategy for each side can be computed mathematically. The rules of the game are given in advance and are not under the control of the players.

Application of the theory to real situations is limited to two-person, zero-sum nonconclusive games. In these situations what one person or organization loses the other person or organization gains.

For most purposes game theory is not yet a completely satisfactory tool. It does make more explicit the factors involved in games or situations involving opposing strategies. In this way it may be a significant aid to judgment and understanding.

The Computer

The essential characteristics of electronic computers are:

(1) It can process data for predetermined purposes at amazing speeds--in some cases millionths of a second per operation.

(2) It plays a pre-decisional role by storing, handling, manipulating, and performing calculations.

(3) It participates in decision making, if it is given relevant data and rules for use, by comparing various ways of manipulating variables and indicating the optimum alternative. Essentially this is the step previously referred to as evaluation of alternatives.

(4) It can play a post-decisional role by measuring results, noting changes, and providing management with information about variations from plans.

In all of the above roles the computer implies a decided shift from intuition, judgment and hunches to quantitative measurement as a basis for decision and action. Overall it should be noted that an electronic computer can do better any job governed by logical rules, regardless of how complicated the rules are. In uncertainty situations, a decision must be made whether to use human abilities or the computer.

Some of the limitations of computers which must be understood to obtain useful results are:

(1) A tendency to feel that results produced from assumptions and calculations have a reliability which is some sort of average of that of the dubious inputs and the accurate calculations.

(2) Many inputs are highly uncertain.[15]

(3) The machine has the advantage of making its synthesis without personal bias from the calculations--it eliminates personal bias. It also tends to eliminate any allowances for the personal biases of the inputs it uses.[16]

In this same vein it has been reported that:

> Rand scientists have concluded that no decision mechanism can be devised that will completely escape the basic uncertainties and complexities that plague large problems of decision.

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[15]Programmers have originated the term "garbigo." It means that if "garbage" is put in the machine, you will get "garbage" out.

[16]Read, Command and Control, p. 7.

and

> Hand calculators say they can improve the methodology of decisions but there is no substitute for sense and sound judgment.[17]

Computers are used to perform a myriad of tasks in government and business and industry. These uses have been generally categorized in two ways. First, to perform routine clerical operations more efficiently than had been possible without the aid of such a machine. Examples are billing functions, payroll computations, and individual bank balances. Second, to solve problems which are too time consuming or costly if traditional equipment and techniques are used.[18] An example of this was the complex program used to determine that the speed and trajectory of Colonel John H. Glenn, Jr.'s "Friendship Seven" capsule were within the limits which would permit orbital flight.

Communication Theory

The development of the computer and the use of new analytical techniques has led to the need for systems which can produce more and more information in less and less time. Information machines, such as the computer, operate by a uniform process of handling data. It begins with input, progresses to storage, then control and processing, and finally an output is received. The mechanization of any part of the information-decision-action cycle breaks down the existing communications channels to which members

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[17] McDonald, "How Businessmen Make Decisions," p. 114.

[18] R. K. Campbell and O. H. Brownlee, "Mathematics for Decision Makers," Harvard Business Review, XXXIV, 3 (1956), p. 49.

of the organization are accustomed. In particular, informal communications tend to disappear and machines do not automatically replace it. Since information is essential to good decisions, the concept of an organization as an information flow process is growing in decision theory. In organization and decision making, problems of communication exist at three levels:

> Level A. How accurately can the symbols of communication be transmitted? (The technical problem)
> Level B. How precisely do the transmitted symbols convey the desired meaning? (The semantic problem)
> Level C. How effectively does the received meaning affect conduct in the dired way? (The effectiveness problem).[15]

Technical problems involve the accuracy with which information, regardless of its meaning, is transmitted from a sender to a receiver. Semantic problems are concerned with the interpretation of meaning by a receiver as compared with the intended meaning of the sender. Effectiveness problems are concerned with the extent to which the meaning conveyed to a receiver produces the conduct desired by the sender. The recognition of these problems has led to the formulation of mathematical theorems regarding the rate at which information may be transmitted and have an arbitrarily low frequency of error.

Improvements in the handling of information have the effect of permitting higher centralization of authority. The impact on decision making of information technology has been compared with present participative management in a prediction for the future.

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[15]Claude E. Shannon and Warren Weaver, The Mathematical Theory of Communication (Urbana, Illinois: University of Illinois Press, 1949), p. 95.

As organizations have proliferated in size and specialization, the problem of control and integration of supervisory and staff levels has become increasingly worrisome. The best answer until now has been participative management. But information technology promises better answers. It promises to eliminate the risk of less than adequate decisions arising from garbled communications, from misconceptions of goals, and from unsatisfactory measurement of partial contributions on the part of dozens of line and staff specialists.[20]

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[20]Harold J. Leavitt and Thomas L. Whisler, "Management in the 1980's," Administrative Control and Executive Action, edited by B. C. Lemke and James Don Edwards (Columbus, Ohio: Charles E. Merrill Books, Inc., 1961), p. 783. Information technology is defined in the reference as having diverse roots which have in common a concern about the systematic manipulation of information in individuals, groups, or machines.

CHAPTER VII

CONCLUSIONS

Our basic knowledge for understanding decision making is provided by the older established disciplines. They have contributed not only to decision theory and decision methods but are integral parts of the interdisciplinary approach of the newer analytical techniques and theoretical approaches. In great measure the older disciplines are found in all of the recent contemporary work. Logic and the scientific method of philosophy pervade all disciplines and newer approaches to decision making such as operations research. Psychology may soon provide a breakthrough in heuristic problem solving which will permit the teaching of methods for solving certain types of problems. Economics has contributed game theory; statistics has contributed sampling and probability theories.

Decision theory provides concepts to be watched for and stimulates further thinking in the total decision-making arena. Decision methods are more directive yet cannot be used mechanically or without a great measure of creativity. Group decision making is a study in social psychology with its emphasis on institutions and sociological problems.

The new analytical techniques and theoretical approaches are important weapons in decision making. They are not a substitute for human decision

making, however, since their function is a supporting one. It is the responsibility of the decision maker to insure that the new techniques are brought to bear in a controlled way.

It should now be apparent that decision making can be improved through knowledge and understanding of many disciplines, theories, methods and techniques. In addition, a decision maker should:

(a) Develop problem sensitivity through awareness of his environment, his organization's objectives, and the relationship which his organization bears to political, social and economic events.

(b) Apply rational methods to problem analysis yet be alert to detect his own and others irrationality and biases.

(c) Seek a wider range of experience and knowledge so that his decision-making skills are increased and improved. This should include the strengths and limitations of the newer analytical techniques and theoretical approaches.

(d) Develop creativity in decision making, particularly in seeking and considering alternatives.

(e) Recognize that there is a variety of approaches to decision making. They include: (1) intuition and hunches; (2) educated professional judgment; (3) formal yet flexible decision methods; (4) new analytical techniques and theoretical approaches.

APPENDIX A

SAMPLE TEST OF OBSERVATIONS AND INFERENCES FROM

"TEST YOUR JUDGMENT," NATION'S BUSINESS,

JANUARY, 1962

SAMPLE STORY

The lights were on at 10 p. m. on June 6, 1961, in an office of the P. Q. R. Company. Lettering on the door of this office read: "L. D. Jones, President."

STATEMENTS

1. There was lettering on the door of the office.

TRUE? FALSE?

(This is true because the story specifically mentions lettering on the door.)

2. There were no lights on in the office on the evening of June 6, 1961.

TRUE? FALSE?

(This is false because the story specifically mentions that lights were on in the office that evening.)

3. L. D. Jones is President of the P. Q. R. Company.

TRUE? FALSE?

(This is questionable since the story specifies only the lettering on the door. Mr. Jones, for instance, could have died recently.)

4. The lights in the office were on at 9 p. m. on June 6, 1961.

(This is questionable because unspecified. Someone could have turned the lights off for a while about then. Or the lights might not have been needed until later.)

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